THE ROMANCE

OF

LIFE PRESERVATION

amongst the waterside public-houses. Both in winter and summer the Society is instrumental in preventing many fatalities, particularly in the London parks. The casualties on the Serpentine alone in 1886 were:—Twenty boating and other accidents; 112 persons were rescued whilst bathing, one person was drowned while bathing, six committed suicide, and five were prevented doing so by the Society's boatmen.

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The work of the Society has doubled within the last twenty years, although the voluntary assistance accorded it has not kept pace with its usefulness—a circumstance which, doubtless, may be remedied by a wider publicity to the history and character of the Institution.

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OR,

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THOMAS CARLYLE.

THE ROMANCE

OF

LIFE PRESERVATION

BY

JAMES BURNLEY
AUTHOR OF "THE ROMANCE OF INVENTION," "TWO SIDES OF THE ATLANTIC," ETC.

LONDON
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PREFACE.

The saving, rescuing, and preservation of life are essentially matters of romance. We can hardly approach the subject at any point without having our emotions stirred to active sympathy or admiration, for the record is alive with deeds of daring and endurance, heroism and suffering, self-denial and devotion. So, although in the following pages the chief aim has been to bring into one connecting link the leading facts and incidents relating to the origin and growth of the various organizations and measures which man's humanity to man has devised for the protection of life, the romantic phases of the inquiry have, it is hoped, been sufficiently dealt with to justify our title.

Many books and articles have been written on separate branches of our subject, but, so far as I am aware, it has not been previously attempted to embrace in one comprehensive view the entire scope of life-saving efforts. In framing such a sketch I have naturally been compelled to be as concise as possible, seeing that a whole volume would have been little enough for the thorough treatment of some of the sub-divisions; still, all the more prominent features have received attention. Much literary and scientific labour has been laid under contribution in the bringing together of the scattered materials, but the main sources of information are indicated in the text. It would have been easy to have expanded the narrative portions of the volume, but my object has been to trace the development and present condition of our life-saving resources rather than to give a series of exciting stories.

J. B.

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CHAPTER I.

THE EFFORTS OF SCIENCE TO COMBAT THE STORM.

The early navigators knew little of safeguards or precautions; in putting off to sea they placed themselves almost wholly at the mercy of the waves, and when storms arose had to trust mainly to the strength of their vessels to carry them safely through. The size of the earliest ships was necessarily inconsiderable. They carried but a single mast and a sail of leather or cloth, and were managed with ropes of broom or hemp. At the termination of a voyage they were drawn on shore. When, however, the keel was added and the size increased, stranding became no longer practicable, and the anchor and cable were invented to confine the ship at a due distance from land. To begin with, the anchor was only a large stone, but was afterwards made of wood and stone combined; and, later on, of iron, having teeth. Then there was a specially large anchor to which they gave the term the "Sacred," this being only cast in the times of extremity. But little real knowledge exists of the early history of ships; there is an abundance of legend, tradition, and conjecture, but scarcely anything of substantial evidence. The great maritime people of antiquity were the Phœnicians, whose ships monopolised the entire trade of the Mediterranean for many centuries; their merchant fleets sailed from the Syrian sea into the Ægean, the Euxine, and the Tyrrhenian seas, and to the Western Mediterranean; and established colonies that perpetuated their naval renown. In the art of shipbuilding they were in advance of all other nations; still, in the matter of navigation—the steering from place to place and the avoidance of storm dangers—they must have been at a great disadvantage, seeing that they had no conception of longitude, or any means of determining it. They sailed by guess, and when perils encompassed them battled with them as best they could, science lending but scant aid.

The ships in which the Saxon pirates cruised in the German Ocean, and invaded Britain, we are told, were made with a wooden keel, with sides and upper-works of wicker, and exterior of hides. Such small progress was made in ship-building that it was not until the fourteenth century that the war-galleys of the olden times began to give place to larger vessels moved by sails instead of oars. They were of crooked, half-moon shape, very high at the stem and stern, the planks nailed with iron, and not set edge to edge and calked. For the most part they had but one mast, never more than two, with square sails attached to yards, and were only capable of advancing with a favourable wind.

Sir Walter Raleigh wrote: "Whoever was the first inventor of ships, every age has added somewhat to them, and in my time they have been greatly bettered. It is not long since striking the top-masts has been devised, together with the chain pump, which taketh up twice as much water as the old one. We have now skidding sails, and the weighing of anchors with the capstan ; moreover, we have fallen into consideration of the length of cables, and by it we resist the malice of the greatest winds, for true it is that the length of the cable is the life of the ship."

The art of navigation, however, received its greatest aid by the introduction of the mariner's compass, the most important of all the instruments employed by the navigator. Although it is said to have been known to the Chinese more than a thousand years anterior to the Christian era, it did not find its way to Europe before the thirteenth century, and was not in general use until a much later period. Columbus discovered its variation in 1492. Thenceforward the sailor had not to rely solely on his knowledge of the land. The discovery of America may be regarded as one of the first direct results of the application of the mariner's compass ; but as the navigator's sphere of operations became enlarged, he was brought into contact with fresh perils, and to obviate them was driven to the adoption of new expedients. When, towards the end of the fifteenth century, a ship was able to set out with a compass, a cross-staff or astrolabe, a table of the sun's declination, a correction for the altitude of the pole-star, and a not over-reliable chart, it was deemed to be splendidly equipped for all emergencies. In 1470, almanacks were first published in Poland, and three years later were in use in England. They gave tables of the sun's declination, and that of many of the stars, and tables for finding the latitude by the pole-star and the "pointers." Until the fourteenth century, paddles had been used to steer by, but these now gave way to rudders, which soon became universal.

After Columbus had traversed the larger world of waters, comprising the stormy Atlantic, and the course of navigation had been extended until the mightier Pacific had been explored, the ships that had sufficed for quieter seas had to be greatly improved upon. Science was laid under contribution now in all things relating to ships. The lateen sail was superseded by the square sail, and that in turn gave way to the trapezoidal sail, as far as small vessels were concerned; while the old clumsy hulls were displaced by models of great beauty. Men began to inquire into the effects and properties of waves, to study the action of wind on the sails; and, generally, to adapt the ships to a better resistance to the dangers of the seas.

In the first known work on shipping, by Sir Walter Raleigh, an attempt is made to describe the improvements which an enlarged necessity had brought about. "We have added crosse pillars," he wrote, "in our royall ships to strengthen them, which, being fastened from the kelsom to the beames of the second decke, keep them from rattling or from giving way in all distresses. We have given longer fleures to our ships than in elder times, and better bearing under water, whereby they never fall into the sea after the head, and thereby shake the whole body; nor sincke sterne, nor stoope upon a winde, by which the breaking loose of our ordnance, or the not use of them, with many other discommodities are avoided. And, to say the truth, a miserable shame and dishonour it were for our shipwrights if they did not exceed all other in the setting up of our royall ships, the errors of other nations being farre more excusable than ours."

Little by little, improvements in the art of navigation came to be introduced, though it is not until we come to comparatively recent days that science has really grappled successfully with the storm, and even now much remains to be done before the knowledge we possess in this direction is effectively and completely utilized. A brief allusion to some of the principal aids to navigation discovered and brought into use prior to the present century may be of interest at this point.

As we have seen, the earliest anchors were nothing but stones. Wood and iron succeeded, but with all the improvements of modern times there has been little change of form in this instrument.

At a very early period the cross-staff appears to have been used by astronomers for measuring heights and distances, and more recently by seamen for calculating altitudes. It was one of the few nautical objects used by Columbus and Vasco da Gama.

The astrolabe was found to be more convenient than the cross-staff, and was in common use at the beginning of the sixteenth century. It could not be used, however, for measuring distances. In 1534, Gama produced what was called an astronomical ring, which he presented to the secretary of the King of Hungary. He claimed for it that it could accomplish all that had been said of quadrants, cylinders, and astrolabes. Something of this kind was possessed by Sir Francis Drake. In the museum attached to the Royal Naval College at Greenwich there is exhibited such an instrument, said to have been used by Sir Francis prior to 1570.

The mariner's compass has been greatly improved during recent years. The compass box and hanging compass were invented by William Barlowe, an English Divine and Natural Philosopher, in 1608. In the latter half of the eighteenth century, the deviation of the compass needle was observed by Mr. Wales, who accompanied Captain Cook on his voyages of discovery as astronomer; but the first attempt to correct the deviation was made by Captain Matthew Flinders, who discovered it while on a surveying expedition to Australia in the beginning of the present century. He suggested the introduction of an upright iron stanchion, so placed as to counteract the ship's attraction, and the explanation then given by him of the action on the needle of the ship's iron has formed the basis of all subsequent investigations. More recently, the introduction of iron in the construction and equipment of vessels has stimulated inquiry in order to detect the causes of the vagaries of the needle, and apply a remedy which should make the compass a thoroughly reliable instrument.

The art of navigation was greatly assisted by the introduction of the Nautical Almanack. In former times mariners were much indebted to the books of predictions known as ephemerides, compiled for the use of astronomers. The problem of longitude and latitude is capable of solution only in connection with some "prediction" of the absolute positions of the heavenly bodies at the time when the observations are made upon them. This annual volume of predictions constitutes the Nautical Almanack. It had its origin in England about the middle of the last century, and owes its existence to a memorial presented to the Commissioners of Longitude in 1765 by Dr. Maskelyne, which, after setting forth many facts and experiments to prove the utility of the lunar method of obtaining the longitude at sea, concludes with the statement that "nothing is wanted to make this method generally practicable but a Nautical Ephemeris." The first volume was that issued for the year 1767, and the work has continued to be published annually ever since, being remodelled in 1830 by the Committee of the Astronomical Society of London.

The question of determining the longitude at sea was under the control of the Commissioners of Longitude from 1714 down to 1828, during which period they disbursed in all a sum of £101,000, mainly in rewards. They offered £10,000 for a method of determining the longitude within sixty geographical miles, to be tested by a voyage to the West Indies and back; £15,000 for its discovery within forty miles; and £20,000 within thirty. A sum of £10,000 was also offered for a method that came within eighty miles of the shores of greatest danger. But no grant in this connection was made before 1737, the first grant being made in that year, and the last in 1815. It is to be regretted that much of the money spent by this Board was wasted upon projects that bore small practical result.

The chronometer perfected by John Harrison solved the problem of longitude, and it was he who, after many years' delay and much neglect on the part of the Commissioners, received the £20,000 reward. "It may be fairly said of John Harrison," writes Dr. Smiles, "that by his invention of the chronometer—the ever-sleepless and ever-trusty friend of the mariner—he conferred an incalculable benefit on science and navigation, and established his claim to be regarded as one of the greatest benefactors of mankind." At the present day the determination of longitude can be relied on to between two and three miles by the chronometer.

All aids to navigation, whether in the form of instruments for ascertaining a ship's locality or directing its course, whether for affording warning against, or protection from, dangers, are so many interpositions of science for the safety of ships and seamen from the strife of the waves. All the seas of the world have been embraced in these later days within the far-reaching arms of science; not only does a ship set out with a plentiful supply of scientific apparatus, but the accumulated experience of centuries of navigation has left its impress and record—in some cases imperfectly, no doubt, but, as regards the main routes of sailing, with a clearness that is of the greatest advantage—for the guidance of the mariner in all ordinary emergencies. Cartography was one of the earliest sciences of the sea, and is to-day one of the most valuable. Sea-maps were undoubtedly in use by the ancients, for guiding their barques in their voyages of adventure or profit, but it is not until we touch the period of the inauguration of maritime enterprise among modern nations that we get at anything definite in the way of charts. Prince Henry, Duke of Visco, is credited with their first introduction into the marine service of Portugal about the year 1400. The first chart made in England appeared in an almanack printed on vellum in 1520. Some forty years later, John Rotz, a Frenchman, made for Henry VIII. "A Book of Hydrography," containing charts of the sea-coast finely painted on large skins of parchment. The early charts, however, did not cover any great extent of surface, and they contained many errors, which were exposed by Martin Cortes, Petrus Honius, and Edward Wright, a treatise by the last-named, entitled "Certain Errors in Navigation Detected and Corrected," published in 1599, being of especial value. One of the most famous charts of the sixteenth century was that of Gerard Kauffman, more familiarly known as *Mercator*, a Flemish geographer. This was published in 1556, but its utility was lessened by the fact that "the intervals between the parallels did not agree with the differences of the corresponding meridional parts of those parallels," a deficiency which Wright supplied in his book already mentioned. The work of chart making has since then been prosecuted with great activity, the English nation having published about 3,000 different charts, and the French nearly as many. The English Hydrographic Department was established in 1795, from which date all matters relating to charts and sailing directions, coast surveys, and the like, have been under its control.

It is only within a comparatively recent period that science has grappled with the storm in real earnest. Before this could be done with much prospect of success it was necessary that the nature and properties of these visitations should be understood. In ancient times it would have been termed "presumptuous" to attempt to investigate grand natural phenomena, but in these days we carry our researches into such things to the utmost limit that our knowledge and experience will take us, knowing that every fresh deduction is an additional safeguard to human life. Dean Swift, once upon a time, gave a recipe for manufacturing a storm. "For your tempest," he wrote, "take Eurus, Zephyr, Auster, and Boreas, and cast them together in one verse; add to these, of rain, lightning, and thunder—the loudest you can--*quantam sufficit*. Mix your clouds and billows well together till they foam, and thicken your description here and there with a quicksand." For a flight of imagination this might pass, but these are hardly the ways of nature. "As fickle as the wind," used to be a metaphor much in use with sentimental swains in regard to the changeable objects of their affections; but this was a libel on the wind, for modern science informs us that this fundamental element of the storm is controlled and directed by laws as fixed as those which regulate the starry firmament, and is a beautiful and wonderful agent in the economy of our system.

Amongst the earliest labourers in this field of research were Sir William Reid, of the Royal Engineers, and Mr. Redfield, of New York. Mr. Henry Piddington of Calcutta published, some thirty-five years ago, "The Sailor's Horn Book for the Law of Storms," in which the plainest instructions were given for the navigation of ships through the dangerous cyclones of the Indian seas; and previous to that Dr. Thom had made public his "Inquiry into the Nature and Course of Storms in the Indian Ocean." Mr. C. M. Meldrum, M.A., also wrote on the same subject, in 1873; and Professor Dove, of Berlin, has done much towards an elucidation of the Law of Storms in his remarkable treatise thereon. The name of the indefatigable navigator and philosopher, Lieutenant Maury, of the United States Navy, has also to be remembered with gratitude in connection with the study of storms. In prosecuting the researches necessary for the demonstration of the dangerous consequences of neglecting the indications by which storms are invariably preceded, and the pointing out of the means for their avoidance, these men have worked with a zeal worthy of all praise.

By far the greater number of storms at sea belong to the class known as revolving storms, such as hurricanes, typhoons, cyclones, &c., created by a disturbed condition of the atmosphere extending over a circular area varying in diameter, according to the locality in which it occurs, from fifty to a thousand miles. A knowledge of the laws of these storms indicates to the seaman his readiest means of escape from them. Their characteristic is that they blow continually round and round a centre or vortex, the gyration invariably taking place in one direction, and that direction contrary to the apparent course of the sun; so that in north latitudes these storms revolve from right to left (or in the opposite direction to the hands of a watch), and in south latitudes from left to right (or in the same direction as the hands of a watch). The mariner who understands this knows the position of the vortex with respect to the locality of his vessel, and is able to make the necessary calculations as to the best way to work himself clear.

These revolving storms are common to the three great oceans, the Atlantic, Indian, and Pacific, but seldom occur within less than 5° or 6° of the equator, and are never found in very high latitudes. They prevail mostly from July to October or November, and are most severe in the West India, Madagascar, and China seas. The movements of these storms have been carefully traced, and their several characteristics analysed with great care and ability. One of the surest warnings of the approach of a revolving storm is the sudden falling of the barometer. In the centre of some of the most severe storms it has been known to fall as low as 27·7 inches. One valuable general rule for emergencies of this kind has been laid down, under the authority of the Hydrographic Office, "for all vessels, in all cases, except when controlled by land or shoals." It is thus set forth:—"Let them immediately steer in that direction which will most quickly increase their distance from the vortex, or centre of the storm-field. But then let it be remembered that the whole storm-field is itself in motion; that it is travelling with certainty to the westward, while within the tropics, though with very uncertain velocity; and that it has a tendency to curve round to the northward in northern latitudes, or to the southward in southern latitudes when leaving the tropics. The situation of the vessel must therefore be considered, not only with respect to the present position of the vortex, but also with respect to the place to which it will have advanced by the time she may have executed any projected run; for otherwise, though going at her best speed, she might be overtaken by a following, and probably an expanding storm." Additional directions of a very elaborate kind are also given, constituting gratifying evidence of the way in which science has come to the help of the seaman when placed in peril by these most serious of all storms.

Often, however, the storm is too violent to be overcome by acts of seamanship alone, and it is to the saving of life that the efforts of officers and men have to be confined. When the ship fails to afford a place of safety, then is the time for good discipline and bravery to make the most of such appliances as are at command for the preservation of human life. With all our scientific knowledge, and with all our preventive legislation, it cannot be said that in these matters our ships are sufficiently equipped. The means provided are greatly inadequate, and to the limited extent of their capacity often fail to render service in the last extremity. Referring to this question of insufficient boat accommodation, Admiral Jasper Selwyn writes:—"With regard to our passenger steamers, few people understand the discrepancy between the Board of Trade requirements and actual practice. I have been across the Atlantic several times in 6,000 ton vessels, carrying actually from 1,500 to 2,000 passengers, capable of carrying with ease 3,000 passengers. There were probably boats on board, which, in case anything happened to the ship, would have carried from 200 to 300 passengers, supposing all those boats had been got into the water without damage, a thing you can scarcely expect from an undisciplined crew, and still less disciplined passengers; and supposing that every precaution had been taken." It is to be feared that in the majority of cases this is something like the condition of affairs on board ship in regard to the saving of life. The provision of adequacy is not enforced. Appliances for saving life at sea are of two classes, one applicable to the saving of individual lives, and the other to saving collective lives. Of the first, the various improved life-belts, life-jackets, life-buoys, floating mattresses, and portable articles of various kinds, it is not necessary to say more than that they are well worthy of attention; and it ought to be compulsory upon owners of passenger-carrying vessels to provide a sufficient number of these appliances. With respect to the supply of boats, it has recently been reported, in connection with a Departmental Committee appointed by Mr. Mundella, in 1886, to inquire into these things, that "the boats should be increased 100 per cent., and approved rafts of collapsible boats should be added."

A measure has already been before Parliament, which provides that every vessel above fifteen tons burden navigating the ocean, or any river, lake, bay, or sound, shall be provided with such boats, life-boats, floats, or rafts as the Board of Trade shall determine. Vessels carrying passengers are to be provided at all times with a serviceable life-buoy or belt, of a pattern approved by the Board of Trade, for every passenger carried, and for the officers and crew. These are to be kept in good order and in accessible places on the vessel, in readiness for immediate use in case of accident; non-compliance with the Act to subject the master to a penalty of not less than £5, or more than £100. Although the pressure of other business in Parliament has retarded the passing into law of this measure, there is an evident desire that more effective means than have hitherto been adopted should be secured for the preservation of life at sea; and it is to be hoped what is done will be thorough, and such as will give the public better confidence.

Much ingenuity has been expended upon the production of life-saving appliances. The contrivances are various, and every year sees something fresh brought out. Empty water-casks, well bunged up, form a ready and reliable means of preserving the buoyancy of the human body. A thirty-six gallon cask, with ropes attached to hold on by, is capable of supporting ten men. Then there are life-rafts, consisting of square frames buoyed up by a cask at each corner. Frames of bamboo, and inflated goat, reindeer, and seal-skins have been largely employed in foreign countries as life-preservers. Jackets and belts of cork in immense variety have been patented; it being estimated that a pound of cork is sufficient to support a man of ordinary size. An improvement upon cork was discovered in India-rubber cloth, which, when inflated, is superior in buoyancy to cork, although it has the disadvantage of being more liable to damage. The air life-belt of Admiral Ward deserves special mention. It consists of four compartments, separately inflated, so that the puncture of one does not quite destroy the belt. A suggestion was made some time ago that the cushions of deck and cabin seats should be constructed on the life-preserving principle, so as to form rafts in cases of emergency, but does not appear to have been acted upon to any appreciable extent. In April, 1878, the British Society for the Encouragement of Arts, Manufactures, and Commerce offered their gold medal to the person submitting the best means of saving life at sea when a vessel has to be abandoned suddenly, and the decision was in favour of cork mattresses faced with hair.

There has recently been revived the ancient idea of "pouring oil upon the troubled waters" when storms arise, and, to a certain extent, the method is successful, though it is obviously incapable of being applied on a large enough scale to be included amongst science's more active agents in opposing the force of the storm. The idea is at least as old as Pliny. In Philemon Holland's translation we read: "All seas are made calme and still with oyle; and therefore the dyvers under the water doe spurt and sprinkle it abroad with their mouths, because it dulceth and allayeth the unpleasant nature thereof, and carryeth a light with it." For many centuries the soothing power of oil was accepted as a fact that only needed demonstration to be substantiated; but it was not until Benjamin Franklin put the matter to the test of actual experiment, that scientific deductions of any value were made on the subject. Travellers had brought many strange tales from abroad respecting the action of oil on the waves. It was said that the fishermen of Lisbon, when about to return into the Tagus, and when the surf on the bar was more than usually rough, occasionally adopted the plan of emptying a bottle or two of oil into the sea; thereby allaying the breakers sufficiently to allow a boat to pass in safety. People were told that in the harbour of Newport in Rhode Island, the sea was always smooth while any whaling vessels were in it; the inference being that the leakage of oil from the barrels spread itself over the surface of the harbour and stilled the waves. It was also reported that a Dutch ship sailing the eastern seas in 1770, encountered a storm, and that the captain, for greater safety in wearing the ship had poured oil into the sea. The story was that the salvation of the ship was due to some four quarts of olive oil. These things made a deep impression upon the mind of Franklin, and during his residence in England he made an experiment with a cruet of oil upon a large pond at Clapham, the results of which he clearly described in the Philosophical Transactions. He declared that a spoonful of oil made half an acre of water "as smooth as a looking-glass."

Franklin subsequently repeated the experiment on a larger scale at Portsmouth and elsewhere, and was fairly successful. In trying to account for this quieting of the waves by oil, the philosopher supposes that, when a film of oil is on the surface of water, the air has nothing to catch hold of; that it slips over the oil, as a greasy pig's tail would slip out of the hands of Hodge at a fair; and that it cannot wrinkle the oil, or wrinkle the water beneath the oil. It is unable, however, to stop the deep, full wave; it can only kill the little undulations with which these greater waves are embroidered. Science cannot get much further than this. Since Franklin's day, the experiment has been repeatedly tried, and upon very stormy seas, but the action of the oil is only to make the waves smoother of surface, not to diminish them greatly in volume or force.

Of a much more practicable and useful character have been the precautionary measures adopted in regard to the building of harbours of refuge, which consist of one or more breakwaters, forming a barrier either complete or partial to the progress of the waves, and which from their position and size serve as a safe retreat for vessels overtaken by a storm, where they can remain unharmed until the gale has subsided. It is essential that harbours of refuge should be accessible at all times; whilst many small commercial harbours can only be entered when the tide is high. The latter are called tidal harbours. It is unnecessary here to devote particular attention to the uses and formations of the various natural harbours, such as the mouths of rivers, creeks, bays, &c.; our concern is with artificial harbours.

It often happens that a port has been established on a site possessing some natural advantages which were sufficient while vessels were small, but that it has to be improved and enlarged for the accommodation of vessels of increasing size. Sometimes, too, a long line of coast is devoid of any natural shelter, in which case the construction of a harbour of refuge prevents great loss of life and property. And it may be that no natural harbour exists in the nearest line of communication with other countries, or is suitably situated for strategical purposes. Under these circumstances, harbours have to be improved and created, and occasionally most unfavourable and exposed sites have to be resorted to, in which the skill of the engineer is taxed to the utmost in providing shelter where waves and currents have previously ruled supreme.

The various works of this description which have been constructed round our coasts are necessarily of stupendous strength and massiveness; still, such is the force of the waves during great storms, that many of them suffer serious damage from time to time. For example, in January, 1877, a portion of the promenade wall of Dover pier was washed away; a length of 150 feet of the sea-wall of the Colombo breakwater was deflected by the waves during the south-west monsoon of 1878; the outer arms of the Madras breakwater were laid in ruins by a cyclone in November, 1881; and hardly a year passes without some casualty of the kind being reported.

The most marvellous instance, however, of the power of the sea is afforded by the movement of a mass of masonry set in cement, and weighing 1,350 tons, which had been built as a termination to the breakwater in Wick Bay. This mass having been specially designed in 1871 to protect the outer end of the breakwater, which had suffered damage on several occasions, was itself carried away in December, 1872. It rested upon two courses of 80 and 100 ton blocks laid upon the rubble base of the breakwater, to form a level foundation five feet below low water; it was about 45 feet wide, 21 feet high, and about 26 feet long. The repeated blows of the waves during the storm gradually turned the huge mass round on its base, and at last tilted it off its foundation on to the inside of the pier.

Legislation has co-operated with science to a considerable extent in adding to the safety of our ships and seamen. An Act was passed in 1861 for deepening rivers, and creating or improving harbours. In seventeen ports, in the twenty years following this enactment, no less a sum than £23,582,733 was expended, towards which £982,352 was advanced by the Public Works Loan Commissioners. At Liverpool the outlay was £7,500,000; on the Tyne, £3,300,000; on the Clyde, 3,144,000; at Barrow, £1,928,250; at Greenock, £1,300,000; at Dublin, £1,161,986. The advantage to navigation, and the security to lives thus effected are incalculable.

One of the most valuable of the contributions of science to help man to avoid the dangers of the storm has been in the establishing of a system of storm warnings. Mr. Renfield, whose work on the Law of Storms we have previously referred to, was the first to suggest the transmission of intelligence of storms by the electric telegraph. This was in 1847. The various attempts made by him in America to carry his idea into effect did not have any immediate result, and were much retarded by the Civil War of 1861. France was the first European nation to take the matter up officially. In February, 1855, Leverrier obtained the sanction of Napoleon III. to the creation of an organisation for the purpose of distributing weather warnings over the countries included in the scheme. It was some years, however, before the system was in practical operation. Leverrier's plan was, as described in a letter to Sir G. Airy, in 1860, to establish an organisation whose work it should be "to announce a storm as soon as it appears at any port in Europe, to follow it on its course by means of the telegraph, and to give timely notice of it to the coasts which it may reach."

The question of storm warnings had for some time been attracting attention in this country, and at the British Association meeting at Aberdeen in 1859, presided over by the Prince Consort, a resolution had been passed in favour of their introduction. A sort of experimental warning was dispatched in 1861 by Admiral Fitz Roy, and in the spring of the following year his system was definitely established, and has since met with general acceptance throughout Europe. At first he tried to accomplish too much, and sent out warnings covering an interval of three days, a period which experience has proved to be too long.

Referring to this system, Mr. R. H. Scott, writes:—"The basis of his signal system was the employment of solid figures, what are called mathematically, solids of revolution, to convey his messages. The use of flags was objectionable, as these are employed for many other purposes besides storm signalling. Of such solids there are three simple forms, the sphere, or *ball*, the cylinder, or *drum*, and the *cone*. If any of these are hoisted on a flagstaff they will always present the same form to the eye at a distance, no matter how they are blown about. The ball will be a circle, the drum a rectangle, and the cone a triangle. Of these forms the ball was already pre-engaged, at least in our harbours, *e.g.* for conveying tidal signals as to the height of water on a bar. Admiral Fitz Roy, however, adopted the two others. With him, the cone, point upwards, indicated a gale from a northern point; reversed, it showed that the gale was to be expected from a southern quarter; and the drum announced 'dangerous winds from opposite quarters successively.' In this country the use of the drum has been abandoned, as it was found that little practical advantage could be gained from it. Our area is so small that we generally have only time to announce the existence of a storm, without attempting to indicate its probable violence—a quality only to be learnt from reports of its effects."

The cone and drum signals, in various combinations, are now in use throughout Europe, except in Holland, where the storm-indicating apparatus used consists of a bar or cross piece like a ship's yard, hoisted on a mast, which can be swung round so as to point in any direction. In the United States they have a very elaborate system of flags and lamps, the former for the day, the latter for the night. As far as this country is concerned, the system we have adopted has been of very great service. More than half the signals of approaching storms have been fully justified. A further testimony to the utility of the work is afforded by the fact that a circular was issued by the Meteorological Council in 1881, asking for expressions of local opinion as to the value of the warnings, and that of the 135 replies received they were, with few exceptions, unanimously favourable. The storm warning system erected by Admiral Fitz Roy has now been in existence over a quarter of a century, and in connection with the telegraph service is yearly extending its usefulness. There is still room for a great expansion of the organisation, especially in reciprocation with other countries; but, even as it is, it has been the means of effecting a great saving of life and property.

CHAPTER II.

GREAT DISASTERS AND HEROIC DEEDS.

The tragic annals of the sea are crowded with incidents of death and disaster which might have been avoided or greatly mitigated if responsible authorities and officials had but adopted proper precautionary measures and appliances. The record is one in which deeds of splendid heroism are strangely blended with acts of wanton and culpable neglect. Science, invention, and legislation have done much—though by no means enough—for the protection of life at sea; still, the men in charge of our ships, from the owners down to the humblest mariner, have often displayed such a reckless disregard of precautions concerning the lives entrusted to them, that not even the wonderful personal bravery and self-sacrifice which they have shown in the moment of peril can be accepted as sufficient atonement for their omissions. A reference to some of the more serious shipwrecks of modern times will make only too clear the catalogue of criminal defaults. Seldom, indeed, in sudden danger, has a ship been found to be fully equal in its equipment and appliances to the preservation of the lives of its passengers and crew, when these have been numerous. In the majority of instances the boat accommodation has been woefully inefficient; in some cases bad discipline has been answerable for serious consequences; and, occasionally, unskilful seamanship has led to tragedies of the most painful description. There are times, however, when the force of the tempest is so great that the best skill of the navigator is unable to cope with it. In any of these emergencies, it is well if the life-saving resources of the vessel are of an adequate nature; but seldom is such the case; as a rule, they have been found to be miserably deficient.

The most dreadful of all terrors at sea is that of fire. It appals the stoutest heart. To meet the emergency of fire every ship has a regular "fire-bill," in which each officer and man has his appointed station or duty. The first step is to assemble the crew at quarters, where they are divided up into groups under their proper officers. Every available pump is put in requisition; the hose are led out; a wrecking party is supplied with axes, &c., and a smothering party with wet blankets. Means are employed to prevent unnecessary currents of air; the ship's course is changed with reference to the wind, that the latter may be the least favourable to the spreading of fire; the magazines are furnished with flood cocks by which they may be filled with water; and sentries are posted over the boats to prevent them being lowered without orders. These means—particularly the use of the powerful steam pumps of our modern ships—have frequently been found adequate to control an ordinary fire; but at times, owing to the presence of special combustibles, or the aid which the wind may give to the flames, all hope of saving the ship is quickly abandoned, and reliance has to be placed on such means of preservation as the ship happens to possess.

In the first year of the present century, the British three-decker, the *Queen Charlotte*, 100 guns, while off Leghorn, some ten or twelve miles from the shore, was discovered to be on fire. The flames spread with terrific rapidity. Splendid discipline was observed from first to last, and the utmost efforts were made to save the vessel, but without avail. The lower-deck ports were opened, the scuppers plugged, the main and fore hatches secured, the cocks turned and water drawn in at the ports, and the pumps kept going as long as the men could stand at them. Boats were sent off from the shore to the assistance of the burning ship, and, when the vessel was found to be past all hope of being saved, picked up some of the crew; but Captain Todd, the commander, and his first lieutenant, Mr. Bainbridge, continued to the last to direct the operations of the crew. The captain sat down and wrote particulars of the calamity, for the information of Lord Keith, the admiral, and gave copies of the record to different seamen, desiring that whoever might escape would deliver it to his lordship. Both the captain and the lieutenant perished at the post of duty, and upwards of 670 other lives were lost. One hundred and sixty-seven were rescued by the boats sent from Leghorn, but there does not appear to have been any one saved by life-preserving appliances belonging to the ship.

A scarcely less heartrending disaster was that which befell the *Kent*, East Indiaman, in March, 1825. She had on board a crew of 148 men (including officers), besides 20 private passengers, and 20 officers, 344 soldiers, 43 women, and 66 children belonging to the 31st Regiment; and was bound for Bengal and China. While in latitude 47° 30′ N., and longitude 10° W., she was overtaken by a strong gale, and fears were entertained regarding her safety, much of the cargo consisting of shot and shell, which rolled fearfully. An officer went below to examine the stowage, carrying with him a lantern. A sudden lurch of the ship made him drop the light, which, coming in contact with a broken cask of spirits burst out into wide-spreading flames that from the first seemed to be irresistible. Every available resource was used to check the further progress of the fire. Water was poured into the hold from pumps and buckets, and wet sails were let down upon the flames. Captain Cobb gave directions for the lower decks to be scuttled, the combings of the hatches to be cut, and the lower ports to be opened to admit the waves. Many were drowned by the sudden letting in of the waters, and for a time the ship seemed to be in danger of foundering. But the fire continued to spread. For several hours they had nothing before them but death. The flames were raging in the hold, and were every moment expected to reach the powder-magazine ; but just as the passengers were on the point of yielding themselves up to their fate, a sail was sighted on the lee-bow, the flags of distress were answered by the hoisting of the British colours, and, crowding on all sail, the ship bore down to their rescue. It proved to be the brig *Cambria*, Captain Cook, bound for Vera Cruz. The boats were got out, and the command was given that any man who should dare to enter the boats before the women and children had quitted the vessel should be cut down ; but the utmost discipline and order prevailed, and no such attempt was made. It was a perilous transit from the *Kent* to the *Cambria*, with the fury of the storm around them, but all the women and children were safely embarked. The boats occupied three-quarters of an hour in going and returning, and all the time the conflagration was increasing with terrible rapidity, rendering an explosion more and more imminent. Captain Cobb began to make his final preparations. A rope was extended from the end of the spanker-boom, and along this uncertain outlet the men were told to creep, thence sliding down the cable hanging from it into the boats. The risk was fearful, for the great waves lashed the boats to and fro, and made the task of dropping into them most difficult. Night was drawing on, moreover, and the wreck was already twelve feet below the water-mark. Any moment might be their last. Still the work of escape was steadily continued, and when at last the boat came back for the final time, the men left on the burning vessel were not more than she was capable of taking. If the explosion were averted but a short time longer they might be saved. One by one they crept along the rope, and all were in the boat except the Captain and the few whom terror had completely paralysed, and whom he in vain strove to arouse from their torpor. The guns, which had fallen into the burning hold, began to explode, and the position was one of dreadful peril. Beseeched by the occupants of the boat to think of his own life, the Captain at length crawled across the boom mainyard and lowered himself into the crowded boat, which soon afterwards safely reached the *Cambria*, from whose deck the rescued people watched the burning ship illuminating the heavens with a lurid glare through the night. About half-past one in the morning the magazine exploded with a terrific noise, presenting a sublime and awful spectacle. After that the flames expired in a chaos of blackened timbers, and nothing more was left of the *Kent*, East Indiaman. Eighty-one lives were lost in all, and the list would have been greatly increased but for the admirable discipline enforced, and the example afforded by the officers.

The burning of the *Amazon*, in January, 1852, was a lamentable instance of insufficient precautionary appliances. She was understood to be the largest timber-built steamer in England at the time, and was very luxuriously fitted up, being owned by the Royal Mail Steam Packet Company, and engaged in the West Indian service. When the steamer started out from Southampton, on the afternoon of the 2nd of January, 1852—a Friday—she was regarded as being in every way well-fitted for her voyage. She carried about fifty passengers—amongst them, Major Eliot Warburton, the gifted author of "The Crescent and the Cross,"—and her officers and crew numbered a hundred and ten men. In spite of her fine appearance, however, there was an uneasiness felt by many passengers in regard to the unsatisfactory working of the engines, which frequently became so heated that they had to be stopped until they cooled. One passenger, Mr. Neilson, was in such dread of fire that he could with difficulty be got to go to his berth at night; and insisted on staying on deck until after midnight. The fears which had been excited were only too well-grounded, as it afterwards turned out; for, on the Sunday morning, as the ship steamed into the Bay of Biscay, the alarm of fire was given, and it was discovered that flames had broken out in the vicinity of the engine-room. An effort was made to stop the engines, but the fire prevented their being approached. The same cause hindered the hose being got out. The passengers were seized with panic, and the cries of anguish and terror were fearful to hear, mingled as they were with the wild cries of the animals on board. The steamer, which was making thirteen knots an hour, could not be stopped, owing to the impossibility of getting at the engines. This rendered the lowering of the boats impracticable, although the ship carried nine, four of which were life-boats. So the steamer continued to drive through the waves with her ever-increasing freight of fire, and with every mile the chances of safety diminished. At last the cry arose, "Every man for himself!" and crew and passengers lost all self-control. At this critical moment the captain ordered the forward life-boats to be lowered, but the order came too late, the boats were on fire. A rush was made for the other boats, but it was found that they had been secured on some new principle, of which the persons handling them were ignorant; and the consequence was that three boat loads of poor wretches were capsized into the water, one after the other, and all were drowned. After a time the speed of the vessel abated a little, and an attempt was made to lower the remaining boats. This time their efforts were more successful; five in all got safely away. Gallant attempts were made by one of the life-boats to effect further rescues from the burning ship, but a strong gale arose, and prevented the boat from getting near. In the end the magazine exploded, and the *Amazon* was blown out of existence, the brave captain, Symons, and Major Warburton perishing with her. Fifty-eight lives only were saved out of 160.

One of the most appalling of recent cases of destruction of ships by fire occurred in November, 1874, when the emigrant ship *Cospatrick*, bound for New Zealand from London, was burned to the water's edge in mid-ocean. She had on board 429 passengers, mostly emigrants, and carried a crew of forty-four. About midnight, on the 17th of November, the cry of "Fire!" was heard, and the passengers rushed on deck in frantic confusion. Captain Emslie, aided by his second mate, strove manfully to get the ship's head before the wind, to prevent the flames from being beaten back over the vessel; but she refused to answer her helm. After some delay the order was given to lower the boats, but such was the disorder and confusion, that the moment the first boat touched the water it was capsized, and all its occupants were drowned. Hen-coops, timbers, and other movable articles were thrown to the people struggling in the water, but all to no purpose. Later on they succeeded in lowering two other boats, into one of which forty-two people, and into the other thirty-nine, made their way; and these boats continued by the ship until it went down. The Captain threw his wife into the sea to give her a last chance of life, and leaped into the waves after her; but both were drowned. The two boats made for the Cape of Good Hope, and kept together as long as they could; but they finally drifted apart, and the one in charge of the chief mate passed into the darkness of night, and was never again heard of. The occupants of the other boat suffered the most horrible privations; many died of hunger, some went raving mad and jumped into the sea; and so they perished one by one, until the 27th of November, when the ship *British Sceptre*, of Liverpool, chanced to fall in with the boat, and took on board the few who remained. Ultimately, only three men out of 473 seamen and passengers survived, and these were landed at Plymouth. The great mistake that was made in meeting this emergency of fire was the delay which occurred in handling the boats. All hands were kept at the work of subduing the fire, which it was past all human effort to restrain. If the seriousness of the disaster had been at once recognised, and the crew had been employed in utilising and equipping all the life-saving apparatus at command, the probability is that the greater portion of the passengers and crew would have been saved.

The steamboat *Golden City*, from New Orleans to Cincinnati, on approaching Memphis, about daylight on the morning of the 30th of March, 1882, caught fire.

She was headed for the wharf, and moored in four minutes, but the line parted before many persons could get ashore, and the swift current swept the steamboat in one mass of flames down the river. She carried forty passengers and a crew of sixty. Thirty-five persons were drowned or burned to death. All the officers but the second engineer escaped. This officer first discovered the fire in the cargo; he raised an alarm, and then remained manfully at his post till the fire prevented his escape.

Collisions are a class of disaster which are often more suddenly fatal than any other catastrophes at sea. They generally occur in a fog, during the night, or in a crowded harbour. The Rules of the Road, which are well defined, and accepted nearly universally, are sufficient to enable ships to avoid each other on all ordinary occasions; but there are times when it would seem as if no human care were sufficient to prevent collision. The light of one ship may be burning brightly, and yet, from some unsuspected cause, may be screened to the look-out of another vessel. This has no doubt led to many collisions at night. No rules will supply the want of careful attention to the running lights, the keeping of a good look-out, and the exercise of sound judgment in the management of the ship. Yet all these precautions may be duly observed by one ship, and if neglected by another in close proximity collision may be unavoidable. Such was the case with the *Northfleet*.

This ill-fated emigrant ship, with 379 souls on board, had dropped anchor off Dungeness, on the afternoon of Tuesday, the 21st of January, 1873. The winds were adverse, and she remained in what was deemed to be a position of perfect safety the whole of Wednesday, and at nightfall hoisted her lights and set her watch with all customary precaution. The passengers, who were bound for Australia, were in no apprehension of danger, but pursued their amusements below deck with complete confidence. Nothing occurred to mar their pleasure until about half-past ten, when the men on the look-out caught sight of a large screw-steamer bearing down straight upon them through the darkness. They immediately hailed her, and every possible exertion was made to attract the attention of those on board, but without the least effect. The steamer came relentlessly on, and crashed into the emigrant vessel amidships, with such terrible force that her prow entered one of the berths where a passenger was sleeping. But this was not the worst. No sooner had the collision happened than the steamer backed with all possible speed, and under cover of the darkness stole away without stopping to render the slightest assistance to the damaged ship and its human freight.

A survivor told the story of what followed in simple and graphic language. "Most of the emigrants had gone to bed," he wrote, "and were dropping off to sleep; but I and three other fellows were playing cards at the second table from the midship hatchway. The doctor had been round and ordered them to their berths, as he would not allow playing at so late an hour. Some of us were talking, laughing, and joking innocently, when suddenly I heard a voice on the deck cry out, 'Ship ahoy!' I was wondering what it meant, when I heard a gurgling noise like water, and immediately afterwards a tremendous crash. I rushed upstairs at once. One of my mates got up, dropped his cards on the table, and turning pale as a sheet, ran to his bunk in fright, and endeavoured to hide himself. The other two followed me up on deck. Some of those who had been asleep sprung from their beds without their clothes, which they had stowed away under their pillows, and did not care to put on. When we reached the deck it was dark, and yet not so dark that we could not see around us. There was one light at the masthead, and two others, red and green, under the bow. Just as we got up there was another crash, and we heard the mate, who was a north-countryman, shouting to somebody, though we could not at the moment either see him or them. As we ran towards him we saw a large vessel right against us, with her bow so near that I could have jumped on to her, and a lot of men running about on her deck, 'jabbering' in a tongue that we could not understand. Then the mate turned to me and said, 'I can't understand what they say. You run down below and tell that French fellow to come up; perhaps he can talk to them.' For we had a 'French fellow' among us.

"As I was turning round to go down, I saw the foreigner bearing round with her stern to ours, and a lot of her crew running to the bow with a piece of tarpaulin, which they threw over the figure-head, so as to hide her name. With that she backed water, and got clear of us. The mate was shouting to them all the time, and when he saw this he cried out, 'Ship ahoy! stop and save us, for we have over four hundred emigrants on board;' but it was useless, for she continued to back water, and then shot ahead across our bow, and was away with her black smoke driving in our faces before we could say many words to each other, while they on board her cried out something foreign, which of course we could make nothing of.

"At that moment there were but few on deck. I ran to the hatchway of the married people, and I put my head down and halloed, 'Come up all of you; she's sinking!' And then the doctor, who was standing near, said to me, 'Go down below and lie quiet, and don't make a row, there's nothing the matter.' But I did not believe him, and as I was running for'ard again I saw the boatswain and a lot of the sailors going aft, crying out, 'All hands at the pump!' But first I had a look over the side of the ship, and there I saw as plain as possible a tremendous hole stove in her side, and you could hear the water rushing in like a river. While I was doing this the captain and all the crew had come on deck, and we set to work at the pump with a hearty good-will, for even then we thought we could save her. They tied ropes to the handles of the pump, which was a double-acting one, and we all set to together. We did not get out much, and the ship lay perfectly still, and we could almost feel her sinking. At the same time the captain had got his blue lights out, and was firing them from the quarter-deck; and when he had done that he ordered the men to fire the gun abaft. They loaded the gun, but it would not go off; and so they carried it up to the quarter-deck, and tried it again. All this time those that were below were coming up slowly, and one by one, looking round cautiously as they stepped on deck, with a wild expression in their faces, as if they could not believe it, and did not know exactly what was going on. There were several women who rushed up first, and began to scream and cry. But the captain told them to go down again and be quiet, and wait till they were called, for they could do no good; and so all of them excepting two went down, and their husbands mostly with them, all very scared. Presently the mate, who was superintending at the pumps, said, 'We had better stop, as it is no good trying any longer.' Then the captain came among us and said, 'You go for'ard, my man, and ring the bell as hard as ever you can,' which I turned to do. . . . . As I came along I saw the mate and the storekeeper and two or three of the sailors pulling away at the ropes of the foremost life-boat.

"The wind was beginning to blow and whistle through the rigging, and I could see that the fore-part of the vessel was sinking near the level of the water. The mate cried out to me to give him a hand in lowering the boat for the captain's wife and the women; and I took hold of one of the ropes; but as they were somewhat confused, or the pulleys would not work, we were unable with all our efforts to get the boat down. And as I looked round I saw the crowd on deck getting thicker and thicker, and I noticed the captain's wife coming along wrapped up in a rug, and looking as pale, poor lady, and as sad, as if she were going to die that moment.

"There was a wild panic, I can tell you, among the strong rough men, when it became apparent that the vessel was sinking. The wild rush for the boats, and the mad confusion which took place, were like the trampling of a herd of buffaloes. Poor Captain Knowles, brave as a hero all the time, was nevertheless angered at the reckless selfishness of the men, and he drew a pistol and threatened the big fellows who were leaping helter-skelter into the boats. He said, 'The boats are not for such as you; they are for the women and children.'"

We have not space to follow the narrative further in all its terrible detail. Thus far we have seen what demands are made upon a ship's crew and passengers in time of sudden peril from collision. The rest of the story deals with the desperate struggle for the boats, the rushing, tearing, and shrieking of the panic-stricken emigrants, and, finally, the sinking of the vessel and the last fight for life of a crowd of poor wretches clutching at spars and bits of wreck as long as the strength to do so remains. Only eighty-six lives were saved out of the 379 persons on board. The Spanish screw-steamer *Murillo* was afterwards charged with having caused the disaster, and it was sought to punish the captain of that vessel for his want of precaution and his inhuman conduct; but the Spanish authorities did not, or would not, consider that there was direct legal proof against the *Murillo*, so he escaped; there is little doubt, however, that he was rightly charged.

A collision of a still more disastrous character took place in September, 1878, when the saloon steamboat *Princess Alice*, returning to London from a pleasure trip to Gravesend and Sheerness, and having on board over 700 passengers, was run into by the screw-steamer *Bywell Castle*, off Woolwich, at about eight o'clock in the evening. What happened it is impossible accurately to describe. A scene ensued which has had no parallel on the Thames. Some few clambered on to the other vessel, but nearly all rushed to the after part of the steamer as the bow subsided gradually under water. There were perhaps a dozen life-buoys on board, and some boats were swinging in the davits; but even if they could have been got at they were miserably inadequate. Indeed, the owners of the *Princess Alice* had made no pretence of providing life-saving appliances. Only some 200 souls were saved. In the legal inquiries which subsequently were held both vessels were blamed,—the *Princess Alice* for not porting her helm when she came end on to the *Bywell Castle*, and the latter for not stopping her engines and going astern.

In the spring of the same year—31st May, 1878—two German ironclads came into collision off Folkstone, one of which, the *Grosser Kurfurst*, sank with nearly

300 victims out of 447 hands. The circumstances of the collision were remarkable. The German squadron —which left Wilhelmshaven for Plymouth on May 29—consisted of three vessels, and at the time of the accident was sailing in two columns; the *König Wilhelm*, with the flag of Admiral Von Butsh, and the *Prussien* forming the port division, with the *Grosser Kurfurst* forming the starboard. A fourth ship, which had not joined the fleet, was intended to fill the place in the starboard division represented by the *Prussien* in the port division. The German Admiral was leading the port division, the *Grosser Kurfurst* being within less than two ships' lengths of the Admiral, and bearing slightly abaft the beam. This was her nominal bearing and distance, but in reality she was even nearer, and probably not more than one length intervened between the two ships. In this formation the German squadron came across two sailing vessels hauling to the wind on the port tack, and consequently standing across the bows of both divisions. The *Grosser Kurfurst* had first to give way, which she did at the proper time, and strictly in accordance with the Rules of the Road, porting her helm and passing under the stern of the first of the two sailing ships. But the *König Wilhelm*, which was close to the *Grosser Kurfurst* at the time, and steering a course parallel to her, endeavoured at first to cross the bows of the sailing vessel. In the meantime, the *Grosser Kurfurst* had resumed her original course, and was then lying right across the bow of the *König Wilhelm*, as she came under the stern of the sailing barque almost at right angles to the original course. The captain of the *Grosser Kurfurst*, seeing the terrible proximity of the *König Wilhelm*, immediately put his vessel at full speed, hoping to cross her bows, but the space would not

allow it. He then gave the order to port her helm, thinking he might lay his ship parallel to the course of the *König Wilhelm*, but unfortunately for this also there was neither time nor space, and the only effect of the helm can have been that the stern of the *Grosser Kurfurst*, swinging rapidly towards the approaching danger, must have largely contributed to the force of the shock. The commander of the *König Wilhelm*, seeing the inevitable fate before him, gave the order to reverse the engines, which it is said were actually going full speed astern at the moment of the collision. Even here more might have been saved had everything been as one might have expected aboard the Fleet. The hammocks had been stowed in some unusual place between the boom boats. Had they been in their ordinary place they would have floated away and afforded so many life buoys. As it was, the ship's boats were mostly smashed by the collision. Admiral Butsh, who was below at the time of the accident, was afterwards sentenced to six months' imprisonment for neglect, but the Emperor pardoned him after fourteen days' incarceration.

The mail steamer *Cimbria*, from Hamburg to New York, with 380 passengers and a crew of 110, was run into in a fog, on the 19th January, 1883, by the British steamer *Sultan* of Hull. The circumstances of the disaster were of the most heartrending description. Eight boats were carried by the *Cimbria*, but one after another was capsized as soon as it was lowered; and with those that got away the struggle for life was so hard that they were compelled to repulse the drowning to prevent overcrowding. The captain, officers, and crew showed a splendid courage and self-sacrifice, most of them perishing in endeavouring to save the passengers and do their duty.

The accident to the Cunard steamer *Oregon*, on the 14th March, 1886, at the entrance to New York harbour, is another illustration of the sudden demands of an emergency of collision. The ship had made a very favourable passage from Liverpool, having had fine weather all the way across, and at half-past four on the Sunday morning was run into by a heavily-laden schooner, which showed no light until too close to clear the Cunarder, when she put out a white light, afterwards getting away without being identified. Captain Cottier, who was in command of the *Oregon*, gave immediate orders for the utilisation of the ship's life-saving resources, and all was done that could be done to keep the steamer afloat. The pumps were worked to their full capacity, but had no chance against the volumes of water which were pouring into the vessel. All the passengers were in bed at the time of the collision, and some continued to sleep for an hour afterwards. The greatest order and perfect discipline prevailed up to the time the water flooded the furnaces; but when the stokers and firemen were driven from the fires they rushed for the boats, regardless of everybody else, and the officers had to fight them back with axes and belaying pins. Fortunately, the boats were not required to be put to their full test, or it is probable they would have been found very inadequate to the occasion. The pilot-boat took off 400 of the passengers and crew, and nearly 500 were transferred to the steamer *Fulda*, which happened to come in sight before noon. The only casualty was that a lady passenger broke her little finger. The *Oregon* went down about eight hours after being struck.

In the more recent case of the sinking of the emigrant ship *Kapunda*, off the coast of Brazil, on the 20th of January, 1887, with 300 emigrants and sailors on board, a fatal error of seamanship was brought home to the officer in charge of the *Ada Melmore*, the ship which ran into the *Kapunda*. It was about three o'clock in the morning when the accident occurred. The morning was fine, the stars were shining brightly overhead, and the wind was favourable. Suddenly, the chief officer of the *Kapunda* saw a vessel on the starboard bow, showing no lights, and apparently going in a direction exactly opposite to his own. He immediately gave orders to the steersman to bring the vessel's head nearer the wind, which was then blowing at right angles across the course of both ships from the eastward. The *Ada Melmore*, instead of holding on her course, on seeing the green light of the *Kapunda* on her starboard bow, also put her helm hard down, thus bringing her head to the wind and cutting directly across the new course of the *Kapunda*. The order had been hardly carried out when the *Ada Melmore* crashed into the starboard of the *Kapunda*, which ill-fated ship sank at once, her unfortunate passengers being almost without exception drowned in their beds, and only a fraction of her crew being saved. In the inquiry which afterwards took place it was shown that in order to effect a paltry economy of oil the captain of the *Ada Melmore* had faced the enormous risks of collision, and, further than that, that the outlook had been very inefficient.

As to the other classes of emergencies at sea they are mostly the result of storm, and the catalogue of disasters is an almost unbroken list of inefficient precautions. In the memorable case of the loss of the *Birkenhead* troopship, off the Cape of Good Hope, in February, 1852, there was a lamentable deficiency of boats, and of these some were stowed away and could not be put to use. Three boats, however, were lowered, into which the women and children were hurried, Colonel Seaton standing in the gangway, with his drawn sword in his hand, to prevent any of the men from forcing their way to the boats. "Every one did as he was directed," wrote a survivor, "and there was not a murmur or a cry among them until the vessel made her final plunge. The officers had their orders, and had them carried out as if the men were embarking and not going to the bottom; there was only this difference, that I never saw an embarkation carried out with so little noise and confusion." In little more than twenty minutes from the time when the vessel struck the fatal rock all that remained of the *Birkenhead* were a few spars and some fragments of timber drifting upon the waves. Of about 640 souls only 97 escaped with their lives.

When the telegraph cable steamship *La Plata* was wrecked in the Bay of Biscay, in November, 1874, the boats and other appliances that should have afforded safety proved of little avail. One of the boats was torn from its davits by a heavy sea, and the davits rent the ship's side and helped on the work of destruction; another capsized; the only boat that was got off being the port-quarter boat, with fifteen men in her. There were so-called life-rafts on board, which were stowed one above another and secured on the forebridge, and when the ship went down the despairing crew struggled frantically to get them out and to float them, but in vain. Out of the seventy-five persons on board only seventeen were saved.

Neglect or default of some kind (mostly in relation to the boats) has added materially to the loss of life in many of the great shipwrecks of modern times. In the case of the wreck of the *Atlantic*, on the 20th March, 1873, while making for the port of Halifax, Nova Scotia, in a violent storm, there had been serious neglect of proper precautions; the lead had not been used in sounding, and the watch had not been duly vigilant; omissions which were marked by the severe censure afterwards passed upon Captain Williams and the suspension of his certificate for two years, the punishment being less than it otherwise would have been because of the splendid bravery displayed by him in his efforts to save the lives of his passengers. The ship struck upon a rock a few minutes after three o'clock in the morning. The crash seemed to tear asunder every plank in the vessel. All the boats on the port side were carried away instantly, and as the ship speedily heeled over, those on the starboard side were also rendered useless. The passengers were told to secure themselves to the rigging, as their only means of protection against the fury of the waves. About a hundred and fifty feet distant rose an elevated rock, and to this storm-beaten pile the seamen contrived to carry five lines. From the rock to the shore was a further distance of one hundred yards, and this passage was also bridged by a rope, Mr. Brady, the third officer, and two quartermasters swimming ashore with it and making it secure. Two hundred persons effected the transit from the wreck to the rock, but only about fifty ventured on the more perilous passage from the rock to the shore, and of these many were drowned. The inrush of waters into the doomed vessel was so great that hundreds of the steerage passengers were drowned in their berths, and numbers of those who were able to make their way on deck were either washed away or crushed by the fore-boom, which had broken loose and was swinging to and fro, killing every one who chanced to be within its range. When morning dawned assistance came from the shore, and those who had not already perished were for the most part saved. Captain Williams remained on the wreck, issuing his orders with the utmost coolness, and in every possible way directing, encouraging, and consoling the wretched passengers, and when at last his hands and feet were frozen and he was unable to make any further effort he was rescued by one of the boats. Out of the 931 persons on board the *Atlantic* at the time she struck 481 were lost, including 295 women and children, not one female being saved.

Reckless seamanship was the cause of the wreck of the *Schiller*, in 1875, on the Scilly rocks. She was an iron steamer of 3,600 tons register, and was just completing her voyage from New York to Hamburg. Having made a favourable run across the Atlantic, a thick haze, which gradually deepened into a dense fog, surrounded her on the evening of the 7th of May, but the anxiety of the captain to make a quick passage caused him to risk danger rather than decrease his speed. The fog prevented him from taking proper observations, still it was not until the ship had run into actual peril that the engines were put to half speed and the course of the vessel was altered. The precautions were too late. In half an hour the *Schiller* drove full on the Retarrier Ledge, near the Bishop Rock Lighthouse, and no human effort could save her. Two of the boats were smashed by the fall of the funnel, and the others were washed away. The chance of rescue seemed hopeless. The catastrophe had become known on shore, however, and the life-boats came out from St. Mary's, succeeding, after great difficulty and danger, in taking off forty-one persons, chiefly women and children. But the ship broke up in the midst of the gallant efforts that were being made to rescue her passengers, and 300 men, women, and children perished.

Neglect of ordinary precaution was responsible for the wreck of the Channel steamer *Victoria*, voyaging from Newhaven to Dieppe on the night of the 12th April, 1887. This time, however, the neglect was not on the ship but on shore. A heavy fog had settled over the Channel, and the vessel was approaching Dieppe. The fog-horn signal at the lighthouse on the headland of Ailly was not sounding at the time, and it was the absence of this indication that led to the disaster. If the warning had been given the ship's course could have been altered and the accident avoided. It was ten minutes past four on the morning of the 13th April when the vessel struck upon the rocks with a great crash. Considerable alarm was felt by the passengers at the first shock, but the officers, believing that the vessel would be safely carried off by the tide, assured them that there was no cause for anxiety. As the time passed, however, and the *Victoria* remained firmly fixed, the excitement increased, and when, at 5.15, Captain Clarke ordered the boats to be lowered, many of the female passengers were in a state of abject panic. Unfortunately, during the lowering of one of the boats a lady's cloak became entangled in one of the davits, with the result that the boat almost immediately capsized, the whole of its occupants being thrown into the water. Every effort was made to rescue the people thus put into peril, but in spite of all that could be done several were drowned. The rest of the boats were lowered successfully, and the other passengers and the crew were safely landed.

But there have been many terrible shipwrecks which have been so sudden in their cause and so swift in their effect as to be beyond control or mitigation by ordinary precautionary measures. The catastrophe has reached its fatal completion before any life-saving appliances could be utilized. Although, in the case of the *Captain*, there is little doubt the defective construction of this unfortunate turret-ship was primarily responsible for its loss, human skill or precaution was of no avail when the moment of peril arrived. At sundown, on the 6th of September, 1870, the *Captain* and several other vessels of the British fleet, chiefly ironclads, were cruising off the Spanish coast, when a gale sprung up, which increased as the night advanced. All through the night the storm raged with relentless fury, and when morning dawned and the anxious seamen looked out from one vessel to another not a sign was visible of the *Captain*. She had gone down in the squall. As was afterwards gleaned from the lips of survivors, Captain Burgoyne, who was in command of the ship, was on deck at the time of the catastrophe. The vessel was under steam and sail, with her double-reef fore and main staysails set. At midnight, on the calling of the middle watch, the weather was very threatening. Fresh instructions were given as to the management of the canvas, but before they could be carried out a tremendous sea struck the vessel on the weather beam, and flooded her lower decks. Captain Burgoyne and the men immediately found themselves waist-deep in water, the ship being on her beam-ends, and quivering from stem to stern in her violent efforts to right herself. But she was unequal to the task; she turned right over, and was speedily floating with her keel uppermost, all who were below being drowned. The men of the watch and the captain were the only persons to whom the least chance of escape was open. The pinnace life-boat was seen at a short distance off, keel upward, and they swam towards her, the captain, Mr. May, the gunner, and an able seaman named

Heard succeeding in reaching her. But they were unable to keep their position, the sea was so turbulent. Presently the ship's second launch, with ten men in her, came alongside and took all the little company on board except Heard and the captain. "Come, sir," said Heard, taking his commander by the hand, "let us jump." Captain Burgoyne answered, "Save your own life, my man." As the distance between the pinnace and the launch continued to increase, Heard exclaimed, "Will you come or not, sir?" and when the captain replied, "Jump and save yourself; I shall not forget you some day," he ventured on the dangerous leap, and succeeded in reaching the launch. Captain Burgoyne was never seen again. Only seventeen men out of a crew of 500 were saved. In the inquiry that afterwards took place, the opinion was expressed that the catastrophe was caused by the pressure of sail upon the *Captain,* though that would not have imperilled a ship constructed on sounder principles. The vessel's freeboard was too low, and she did not possess sufficient stability.

A disaster of the purely unpreventable class was that which befell another vessel of the British Navy, the *Eurydice,* on the 24th March, 1878, in a sudden snowstorm and squall off Dunrobe, the last headland of the Isle of Wight which the vessel had to pass before reaching secure haven. H.M.S. *Eurydice* was one of the training ships, and had just returned from a winter's cruise to the West Indies, with a crew of some 250 ordinary seamen and boys, besides passengers, marines, and others. She was struck by a sudden squall of a most furious character, and capsized and sunk with such rapidity that it seemed as if every soul on board had perished. The *Eurydice* was off Ventnor about 3.30 P.M. As then seen by the coastguardsmen, she was under all plain sail. The wind was then about west, which would be on the ship's port quarter. A steady falling of the barometer was the only sign of change; but between two and three in the afternoon, the weather altered completely. A sudden rise of the wind occurred, which shifted to the north, and blew for a short time almost with the force of a hurricane, and then followed a heavy fall of snow, which was not, however, of long duration. Before sail could be shortened, the hurricane struck the unfortunate ship, and veering by the north round towards the east, filled the canvas and bore her over on her starboard broadside so promptly that nothing could be done to get the canvas off her before she was on her beam ends. One of the survivors heard the order to "pipe hands, shorten sail," but before anything could be done the catastrophe occurred. As the weather had been very fine, all the ports were open, and the fury of the wind preventing the vessel righting, she soon filled and went down. As she sank she righted, but the ebb tide seems to have caught her on the port, and canted her to leeward, so that when she took the ground her head was to the southward of east, though her course would have been about north-east.

Various acts of legislation have within the last few years materially added to the safety of ships, sailors, and passengers, in so far as they have laid down a succession of useful and wise regulations as to the conditions upon which only ships are permitted to go to sea. Some of the statutes require the survey of the hulls, machinery, and equipment of passenger steamers and emigrant ships, and several Acts may be said to have been the result of Mr. Plimsoll's agitation on the subject of the unseaworthiness of vessels of the merchant service. For all that, much remains to be done by the Legislature before the best that can be achieved in this direction has been accomplished, and nothing less ought to satisfy a maritime nation like England. It is no pleasing commentary upon the various enactments of later years to be told by so eminent an authority as Mr. Thomas Gray, C.B., that notwithstanding the steps taken in lighting the coasts, and in providing life-boats and rocket apparatus; the improvements to the entrances of harbours; the adoption by the Legislature of nearly all the remedies proposed in 1836, 1843, and 1847; the vast improvements in, and increased safety of, ships; the effective operation in the main of the Grain Cargoes Act, and of the measures taken to prevent the explosion of gas on coal-laden ships; the detention of 1,021 unsafe ships; and the fact that the great Steam Ship Companies rarely lose a life, the loss of life in 1881 had become larger than ever. Of course it has to be borne in mind that all the time we have been improving our provisions of safety our ships have been rapidly increasing in number, and that under the old system (or want of system) the fatalities would necessarily have been proportionately greater. In 1836, there were 25,820 ships on the register of British ships, and their tonnage was 2,792,646 tons. Of these, 600 ships were steamers of an aggregate tonnage of 67,969. In 1886, there were 38,335 ships on the register, of a tonnage of 9,323,615 tons, 8,913 of them being steamers of 4,293,115 tons. Assuming that one steam ton does four times the amount of work of one sailing ton—which is Mr. Gray's estimate—it may be concluded that while in 1836 there were 2,996,553 effective tons of shipping, there were in 1886 not less than 22,202,960 tons.

CHAPTER III.

THE STORY OF THE LIGHTHOUSES.

When man first began to go down to the sea in ships, one of his earliest necessities would be a guiding light to shape his course by when the darkness of night spread itself across the face of the waters. Out on the open sea the stars of heaven would point the way, but when his ship was in proximity to land he would need some friendly beam from the shore to lead him safely to harbour. The first lights of the kind took the form of beacon fires, which were placed on the lofty headlands round the coast at night, and served to indicate to the mariner the points he had to aim at or avoid.

In the ancient literature we find numerous allusions to fires of this description, but the difficulty of feeding and keeping open fires alight on the crests of the hills would soon suggest the need of affording them some structural protection. Thus the transition from beacon fires to fire-towers or lighthouses would be naturally brought about.

Amongst the early maritime nations, lighthouses were not only a recognized aid to navigation, but were invested with a sacredness which constituted them devotional objects as well as guiding marks. There is much that is obviously mythical about the stories which have been handed down concerning the lighthouses of the older civilizations. We do not get at anything really tangible until we come to the celebrated Pharos of Alexandria, which was included among the Seven Wonders of the World; yet even in respect of that remarkable monument of antiquity we are not able to glean anything very precise. The name of its founder does not survive, but we know that its architect was called Sostrates. This ancient lighthouse was built on the isle of Pharos, about a mile distant from the city of Alexandria, and was of white stone. According to Pliny, it cost a sum equal in present value to about £390,000, and was of great height and massiveness. It is not known when or how this great lighthouse ceased to exist, whether it fell to decay by the natural process of time or was demolished by the hands of invaders, but there is evidence that it was standing in the twelfth century. Beyond that we know little or nothing. Indeed, the records of early lighthouse history are so very meagre and unsatisfactory that it is not until we touch comparatively modern times that we are able to trace the existence of anything like a general lighthouse system.

Much speculation has been indulged in with reference to the Colossus of Rhodes, another of the Seven Wonders, which was said to be seventy cubits in height, and of such immense proportion of limb that a man could hardly compass one of its thumbs with his arms. By some the Colossus—which was in the form of a statue of Apollo—was said to have served the purpose of a pharos, and to have stood at the entrance to Rhodes, with its legs stretched across the mouth of the harbour, ships in full sail gliding underneath with the greatest ease. Whether such were its position and object may be doubted, as some of the writers who make most particular reference to it are silent on this point. It was said of Chares, the sculptor of the Colossus, that he had "made a god like to a god, and endowed the world with a second sun." Be that as it may, the statue remained erect only for the short period of fifty-six years, and was then overthrown by an earthquake. For hundreds of years afterwards its prostrate form, with its huge disfigured limbs forming so many vast caverns, was regarded as one of the world's greatest curiosities; and when in 672, on the occasion of the capture of Rhodes by the Saracens, the brass composing the statue was sold for a sum equivalent to £36,000, it took a thousand camels to carry the fragments away. But the evidence of its ever having been used as a light-tower cannot be said to count for much.

We have to come nearer home, and to deal with matters of more recent maritime history, before we can gain a real starting point for our story of the lighthouses. There is an interesting relic of the Roman occupation of Britain in the remains of the ancien lighthouse, still speaking through its crumbling ruins of the storms and tempests of a far-back time, on the summit of the lofty steep overlooking Dover harbour. This was no doubt used as a lighthouse in times anterior to the Conquest, but long before England rose into eminence as a seafaring nation it had been transformed into a military stronghold, and as such continued to be used down to recent times.

Much has been written and conjectured concerning the Tour d'Ordre of Boulogne, erected by the Emperor Caligula in commemoration of his victories; and afterwards utilized as a lighthouse, and so used down to the seventeenth century. All remains of this once famous tower have long since disappeared; but since 1835 its place has been worthily occupied by a lighthouse in which a powerful lighting apparatus has been kept in nightly operation, greatly to the advantage of the navigation of that part of the Channel.

Another celebrated lighthouse of the past was the famous Tour de Cordouan, erected on an extensive reef at the mouth of the river Garonne, serving as a guide to the shipping of Bordeaux and the Languedoc Canal; and, indeed, to all that part of the Bay of Biscay. According to tradition, the first Tour de Cordouan was built by Louis the Debonnair, but there is nothing of actual record to support the story. Let the original structure have been built at what period it may, we know for a certainty that the second tower was erected at the instance of one of our own heroes—Edward the Black Prince—between 1362 and 1370. This lighthouse was forty-eight feet in height, and its light was obtained by the burning of billets of oakwood in a chamber at the top of the tower. A holy hermit had charge of the place, and received a toll of two groats sterling from each vessel entering the harbour. This tower served the purpose for which it had been built until towards the end of the sixteenth century, when Louis de Foix, the architect of the Escorial, was entrusted with the erection of a new one. He began his operations in 1584, and completed the structure in 1600. Mr. Alan Stevenson—no mean authority—has declared that for architectural grandeur the Tour de Cordouan is the noblest edifice of the kind in the world. Time and the rush of waters have committed ravages upon it, entailing various acts of restoration during the many years it has stood the brunt of the storm; but it still remains in much the same form as when De Foix handed it over complete to Henri Quatre. The building is 177 feet in height, and consists of a pile of masonry, forming successive galleries, enriched with pilasters and friezes, and rising above each other with gradually diminishing diameters. These galleries are surmounted by a conical tower, which terminates in the lantern. Round the base is a wall of circumvallation, in which the light-keeper's apartments are formed; the wall serving also as an outwork of defence for receiving the first shock of the waves. The tower itself contains a chapel and various rooms, and the ascent is by a spacious staircase. The upper portion of the structure has been replaced, and the tower considerably increased in height.

In this country lighthouses were in the old days matters of private enterprise. But when Britannia found it her special vocation to "rule the waves," when the sovereigns of England began to have their fleets of war, and our merchant princes had their richly-laden argosies on every sea, stronger measures of protection were necessary than had sufficed for more primitive seafaring. Henry VIII, who, despite serious faults and worse follies, possessed many kingly qualities, was the first English monarch to see the need of an official organization for dealing with maritime safeguards. On the 20th of March, 1512, he issued a royal charter constituting "The Brotherhood of the Trinity House of Deptford of Strand, and St. Clement," whose duty it was to pray for the souls of sailors drowned at sea, and for the lives of those in peril. Henry graciously assumed the rôle of the "pious founder" for this occasion; the brotherhood being established "out of the sincere and complete love and devotion which we have for the very glorious and indivisible Trinity, and also for St. Clement the Confessor." But the holy brotherhood enlarged their office considerably as time went on, and in addition to their prayers began to assume certain functions and privileges giving them authority in maritime matters.

In 1566, the eighth year of the reign of Elizabeth, coast lights and sea marks were formally placed under the control of the Trinity House. The condition of English lighthouses at that time is pretty clearly set forth in the preamble to the Act accomplishing this. "Forasmuch," it reads, "as by the destroying and taking away of certain steeples, woods, and other marks standing upon the main shores adjoining to the sea coasts of this realm of England and Wales, being as beacons and marks of ancient time accustomed for seafaring men, to save and keep them and the ships in their charge from sundry dangers thereto incident, divers ships with their goods and merchandises in sailing from foreign parts towards this realm of England and Wales, and specially to the port and river of Thames, have by the lack of such marks of late years been miscarried, perished and lost in the sea, to the great detriment and hurt of the common weal and the perishing of no small number of people," it is enacted, and so forth.

This is a sufficient indication that the lighthouses round our coasts were not by any means numerous at that time. In 1536 Henry VIII. had granted permission to the Trinity House of Newcastle-upon-Tyne to "found, build, make, and frame of stone, lime, and sand, by the best means which they know or can, two towers, one, to wit, in the northern part of the Shelys (Shields), at the entrance of the port of the said town, and the other on a hill there fit and convenient for signals, meets, and bounds;" and about the same period there were a few lighthouses erected on other portions of the coast, but they were few and far between. Progress in this direction was somewhat hindered by a quarrel which arose between the Trinity House and the Crown, for the former made so much of its authority that its action was often regarded as an interference with the prerogative of the sovereign. The Trinity House claimed, under the Act of Elizabeth, the right of erecting new lighthouses, and of levying tolls for their support, "as it thought fit;" but, on the part of the Crown it was contended that the authority given to the Trinity House "excluded not his Majestie." The fact was, lighthouse tolls became rather an important item as the shipping trade of the country developed, and under the Stuarts were regarded with a covetous eye by the Crown. A sort of compromise was effected, but the advantage of it was mostly on the Crown's side. The King pretended to submit all petitions of private individuals for licenses to build lighthouses to the Trinity Board, but, although as a rule the Trinity Corporation reported against these private projects, the objections were mostly overridden by the Crown: generally for some valuable consideration.

Charles I. was besought to grant a patent to Sir John Meldrum, giving him permission to erect "lightes" on the North and South Forelands, as a protection against the dangers of the Goodwin Sands, but the Trinity Board reported that there was "no necessity for such lighthouses; neither will they be of any use for avoiding the aforesaid dangers." For all that, Sir John got his patent, and thereafter levied twopence a ton for the support of his lighthouses. Sir Edward Howard obtained a patent, in 1614, for the erection of a lighthouse at Dungeness, and the privilege of levying a duty of a penny a ton. Some years later, in 1650, the Earl of Thanet threatened the Dungeness lighthouse with destruction, claiming as his own the land on which it stood, but Cromwell was appealed to in the matter and promised the petitioners that they should "not be subjected to y^e will of y^e Earl of Thannet."

Sir John Killigrew got a patent in 1619, to erect a lighthouse on the Lizard Point, although again the Trinity Brethren entered a strong protest, asserting that it was not "necessary or convenient to erect a lighthouse there; but, *per contra*, inconvenient, having regard to pirates and enemies, whom it would conduct to a safe place of landing." In 1661 this lighthouse was no longer in existence, and in 1751 another lighthouse was erected on the Lizard, under a patent obtained by the Trinity House. In 1679, Sir John Clayton offered to surrender the four lighthouses he had built on the northern coast at a cost of £3,000, on condition that he was permitted to erect one on the Scilly rocks. This was opposed by the Trinity House on the ground that the King had already granted them a patent to erect such a light, and as in the following year they set about the work themselves their opposition did not much matter in this case. On a rock "200ft. in height, within four miles from the rock called Bishop," they built their lighthouse, which was full "60ft. high before y^e^ lanthorn be set up, so that it be about 70ft. high altogether." All ships passing it, outward or homeward bound, had to pay, if English, ½d. a ton, if foreign, 1d. The first keeper of this lighthouse was an individual of a somewhat daring type. The lighthouse had not been completed two months when a terrible shipwreck occurred on the very spot, "Y^e^ Golden Lyon, Virgini ship" breaking itself to pieces at the very foot of the new tower. The fact was, the keeper had seen the ship approaching and had purposely extinguished the light, so that when the vessel was wrecked he was able to "plunder y^e^ goodes of y^e^ ship." What punishment befell him for this evil bit of work is not recorded.

The inhabitants of Cornwall and Devon were not very favourably disposed towards the erection of lighthouses in those days, the matter of the toll being considered a great grievance. Still, our shipping had grown to be such an important feature of the prosperity of the nation that its protection became more and more a necessity, and during the seventeenth century many of the most dangerous parts of the coast were marked by lighthouses. There was no more perilous point, however, than that of the Eddystone rocks, which remained hidden just below the surface of the waves some fourteen miles to the south-west of Plymouth harbour. Very many ships had come to grief on those fatal rocks, and the need for some danger-signal at that point had long been recognized, but the difficulty of building any structure at so dangerous a part was so great that it was not until 1696 that any practical project for accomplishing the feat was forthcoming. In that year, a country gentleman named Henry Winstanley proposed to himself the task of erecting the first Eddystone Lighthouse, and, having obtained the necessary sanction, set to work on the undertaking. It was a long and dreary business, for the work could only be carried on in the summer, and even then the rocks would be submerged by tempestuous seas for a week or a fortnight together. During the first summer twelve holes were bored in the rock, and as many irons were fixed in them as would serve for the superstructure. The next summer saw the erection of a solid round pillar 12ft. high and 14ft. in diameter; the third witnessed the enlargement of the pillar by 2ft. at the base and the carrying up of the structure to a height of 60ft. "Being all finished," wrote the engineer, "with the lantern, and all the rooms that were in it, we ventured to lodge there soon after midsummer, for the greater dispatch of the work. But the first night the weather came bad, and so continued, that it was eleven days before any boats could come near us again; and not being acquainted with the height of the sea's rising, we were almost drowned with wet, and our provisions in as bad condition, though we worked day and night as much as possible to make shelter for ourselves. In this storm we lost some of our materials, although we did what we could to save them; but the boat then returning, we all left the house to be refreshed on shore: and as soon as the weather did permit we returned and finished all, and put up the light on the 14th November, 1698; which being so late in the year, it was three days before Christmas before we had relief to go on shore again, and were almost at the last extremity for want of provisions; but, by good Providence, then two boats came with provisions and the family that were to take care of the light; and so ended this year's work."

Winstanley, however, did not consider the structure complete, so during the fourth year he not only took measures to strengthen the foundation, but added as many ornamentations as if it had been intended for a summer-house. That it was a picturesque object cannot be doubted; still, "a Chinese pagoda, with open galleries and fantastic projections," was scarcely the kind of structure one would look for as the best resistant to the fury of the waters. But Winstanley was as satisfied with its architectural features as he was convinced of its strength. It was his boast that his lighthouse was capable of surviving the fiercest gale that the elements could send. His dearest wish was to be permitted to be in it during a violent storm, to hear the tempest beating furiously against it, and to feel through all that it was secure and firm in every joist and beam. With this heroic impulse strong upon him, he visited the lighthouse during the gloomy days of November, 1703, and after having with difficulty effected a landing, remained, in company with his workmen and keepers, watching, waiting, and hoping for the arrival of a storm which should put his erection to an adequate test. His desire was more than gratified. On the 26th of November, a gale arose and swept across the English Channel with a destructive force that scattered death and devastation far and near. Such a terrible storm had not been known within the memory of man. All through the night the tempest raged with unabated violence, and the inhabitants of Plymouth, kept awake by the fearful noises made by the wind, wondered how it would fare with brave Winstanley. When the first grey streaks of dawn appeared, the people ran to the beach and looked anxiously towards the Eddystone rock. Then, as the dawn broadened slowly into daylight, and the spot became visible, they were horrified to discover that not a vestige of the lighthouse remained; the whole edifice had been swept away by the storm, with poor Winstanley and his workmen, every one of whom perished.

For three years afterwards the Eddystone reef remained undisturbed. Neither private citizen nor public authority came forward to continue Winstanley's noble work. Still, the necessity for a lighthouse at this dangerous point was shown only too clearly by the numerous wrecks which occurred there when the "light" was no longer visible. The *Winchelsea*, man-of-war, went to destruction on those fatal rocks, and nearly all her crew perished. Other disasters followed quick and fast. Then the Trinity House began to move a little, and the Government showed a slowly awakening sense of duty, and after much playing at cross-purposes between the two, as of old, it was in 1706 determined that a new Eddystone lighthouse should be forthwith commenced. A ninety-nine years' lease was granted to one Captain Lovet, who at once took the enterprise in hand. The captain does not seem to have had any notions of his own as to the best course to pursue in regard to the work of re-construction; nor did he consult any practical architect or builder on the business; he simply, in his old-world way, took a fancy to some suggestions that were made by a Ludgate Hill silk-mercer, John Rudyerd, and to him entrusted not only the designing of the new lighthouse, but the entire superintendence of its erection.

Rudyerd, however, was not by any means incompetent. He had given the matter much study, and was prepared with a design greatly superior to that of Winstanley. Instead of a polygon, he chose a circle for the outline, and in all things tried to ward off rather than offer resistance to wind and wave. Oak timber was largely used in the construction of the lighthouse, but solidity was imparted by thick courses of Cornish granite at the base. The tower was not entirely completed until 1709. It rose to a height of 92 feet, and consisted of four rooms, one above the other. The lantern was of octagonal shape, 10 feet 6 inches in diameter, and crowned by a ball of the diameter of 2 feet 3 inches.

In those days the Eddystone workmen had other perils than those of storm and tempest to guard against. England was at war with France, and the Channel was overrun by privateers. The contractors had "two vessels ready with materials and men to be by the rock and watch all opportunities of working that no time be lost in perfecting so useful an undertaking"; but the crews durst not venture out unless a man-of-war was appointed for their protection. Application was made to the Admiralty on the subject, when it was pointed out that the men had no cause for alarm, seeing that "the person that molested those formerly employed was so severely punished by the French King, and the workmen captured were sent back." This reference was to an incident which had happened while the first Eddystone Lighthouse was building, when a French privateer had taken prisoners the workmen engaged upon it and carried them off to France. On this coming to the knowledge of the King—the pleasure-loving Louis XIV. it was—he at once commanded the release of the prisoners, on the ground that the work they were engaged on was one for universal good, and that he was at war with England and not with humanity.

Rudyerd's lighthouse continued to fulfil its beneficent purpose with success until the night of the 2nd of December, 1755, when, from some unknown cause, the building caught fire. It had been in flames eight hours before any help reached the three keepers, who, half dead with fright, were shielding themselves in a small cave on the east side of the rock, from the blazing beams, red-hot iron, and molten lead which fell from the burning structure. The men were with difficulty got into a boat and taken ashore. One of them immediately disappeared and was never heard of again; a second died shortly afterwards through having accidentally swallowed a portion of the molten lead, a piece weighing seven ounces and five drachms having been found in his stomach after his death; as for the third keeper, nothing is said of him, so it may be presumed he came to no harm.

Strange to relate, the authorities were at this stage impressed by the desirability of at once proceeding with the erection of another Eddystone lighthouse. They saw no reason for delay; they wasted no time in disputation; but in the spring of the following year entered into a contract with Smeaton to build a light-tower of more formidable proportions and greater strength than the two which had been destroyed. Smeaton first landed on the rock on the 5th of April, 1756, and at once began to arrange for the foundation. He had the surface of the rock cut into regular horizontal benches, and into these the foundation stones were carefully dovetailed or notched. On the 12th of June, 1757, the first stone was laid, weighing two tons and a quarter. The first course, consisting of four stones, was finished the next day, and by the 11th of August the sixth course had been completed, bringing the erection above the general wash of the tide. After many difficulties, dangers, and interruptions—it being impossible to continue the operations during the rough winter weather—the tower received its last stone, on which were inscribed the words "Laus Deo," on the 17th of August, 1759. The tower was composed of forty-six courses of masonry, and rose to a height of seventy feet; it measured twenty-six feet in diameter at the level of the first entire course; and the diameter under the cornice was fifteen feet. The first twelve feet of the tower formed a solid mass of masonry, and the stones of which it consisted were united by means of stone joggles, dovetailed joints, and oaken treenails. All the floors were arched.

Smeaton superintended all the details of the erection, and incurred serious dangers at times. On one occasion he nearly lost his life. He and the workmen were engaged upon the task of fixing the bars to the windows. "After the boat was gone," he wrote, "and it became so dark that we could not see any longer to pursue our occupations, I ordered a charcoal-fire to be made in the upper store-room, in one of the iron pots we used for melting lead, for the purpose of annealing the blank ends of the bars; and they were made red-hot altogether in the charcoal. Most of the workmen were set round the fire, and by way of making ourselves comfortable, by screening ourselves and the fire from the wind, the windows were shut; and, as well as I remember, the copper cover or hatch put over the manhole of the floor of the room where the fire was—the hatch above being left open for the heated vapour to ascend. I remember to have looked into the fire attentively to see that the iron was made hot enough, but not over-heated; I also remember I felt my head a very little giddy; but the next thing of which I had any sensation or idea was finding myself upon the floor of the room below, half drowned with water. It seems that, without being further sensible of anything to give me warning, the effluvia of the charcoal so suddenly overcame all sensation, that I dropped down upon the floor; and had not the people hauled me down to the room below, where they did not spare for cold water to throw in my face and upon me, I certainly should have expired upon the spot."

The "light" was first exhibited in the lantern on the 16th of October, 1759, but such was the condition of the lighting apparatus that a feeble illumination from tallow candles was the only guiding light that the mariner was permitted to see gleaming from this noble erection. Indeed, much as had been done by Smeaton to make his tower worthy of its position and of engineering science, his efforts were greatly discounted by the jobbery under which the entire lighthouse system of England then suffered. The lighthouse had been leased and underleased, and had got into the hands of unworthy parties, who, regardless of shipwrecks and loss of life, burned the least expensive illuminant, although many improved lighting appliances were in existence. But, in 1807, the lease expired and the Trinity House assumed the control of the Eddystone Lighthouse, which it has never since relinquished. Argand burners were now introduced, and paraboloidal reflectors of silvered copper, and there was an end for ever of the "felonious mutton dips."

For more than a hundred and twenty years Smeaton's lighthouse continued to brave the fury of the waves, and remained as firm as on the day of its completion. But, in 1877, it was made known by Sir James N. Douglass, the engineer to the Trinity Board, in a paper read by him at the Plymouth meeting of the British Association, that the building of a new Eddystone Lighthouse had become necessary. He explained that the structure itself was as strong as ever, but that the rock on which it was built, dashed against by Atlantic storms for countless thousands of years, had become undermined, and would ultimately give way altogether. In the following year, Sir James was commissioned to commence operations in regard to a new structure, and he selected as his site what is called the South Rock, which is so low that it is wholly covered with water till half ebb tide, and some parts of it are permanently four feet under low water. The difficulties he had to contend with were even greater than those which Smeaton had to encounter. But in July 1878 the work was begun, and in the spring of 1882 it was finished. Its height is rather over 170 feet from the foundation course to the vane at the top of the lantern, and the light is 135 feet above high water. In the erection of this commanding tower all the latest aids of science have been employed, and, as it stands, the present Eddystone Lighthouse may be regarded as the most commodious and most effective rock lighthouse in existence. The tower comprises 2,171 stones, containing 63,020 cubic feet, or 4,668 tons of masonry, as against the 988 tons of Smeaton's tower. Its cost was £61,500, while Smeaton's cost £40,000.

It has been necessary to break the order of time somewhat in tracing the history of the four lighthouses erected on the Eddystone reef. We may now go back to the eighteenth century for the purpose of taking up the threads of the general narrative.

When the first Eddystone was built there was hardly another light to be seen on the whole of the southern shores; but as commerce increased, and our merchant navy expanded, a more systematic lighting of our coasts was demanded. The next important lighthouse to that of the Eddystone, in point of date, was the Smalls Lighthouse, off St. David's Head, South Wales, built by a Mr. Philips, "to serve and save humanity." The erection was commenced in 1772, a Liverpool musical instrument maker named Whiteside being chosen as the architect. It took several years to complete, owing to the perils to which the workmen were exposed. At one time they were reduced to such extremities that they were compelled to trust to the chance of a letter, which they had enclosed in a bottle, reaching some friendly hand. "Being now in a most dangerous and distressed condition," Whiteside had written, "upon the Smalls, do hereby trust providence will bring to your hand this, which prayeth for your immediate assistance to fetch us off the Smalls before the next spring, or we fear we shall perish; our water near all gone, our fire quite gone, and our house in a most melancholy manner." This was dated the 1st February, 1777. It produced the desired result, and after that better provision was made for the hardy sojourners on the Smalls Rock. When, many years subsequently, this lighthouse was handed over to the Trinity House, the descendants of the founder received £15,000 by way of compensation. Lighthouse farming was a profitable thing in those days, and even later, for in a report of a Select Committee of 1834, having reference to the Skerries Lighthouse, we find it stated that the lessee or proprietor had strongly objected to disclose the amount of his income, and that when the information was at last wrung from him it was shown that during the seven years then ended he had been in receipt of an annual net income from the lighthouse of £12,525. The present lighthouse on the Smalls was built in 1861, and is a structure of great beauty and solidity.

Scarcely less interesting than the history of the Eddystone is the story of the lighthouse on the Bell or Inchcape Rock, on the coast of Scotland, where so many vessels were wrecked in olden times, that the Abbot of Aberbrothwick caused a float to be fixed on the rock, with a large bell attached to it, so placed that the motion of the waves kept it always ringing. Southey's ballad of "Sir Ralph the Rover" is based on this story. Several warning signals were put up from time to time on this dangerous spot, but they were all washed away. In 1806, however, an Act was passed authorizing the Commissioners of Northern Lighthouses to erect a lighthouse on the Bell Rock, and Mr. Robert Stevenson, the eminent lighthouse engineer, was entrusted with the work. The erection was begun in 1807, and finished, after many accidents and providential escapes, in 1811. Its height is about 117 feet, the light being shown from an elevation of 93 feet above high-water. The cost of the tower was

£61,331. It was in this famous lighthouse, which still stands uninjured by the storms and tempests of nearly eighty years, that Sir Walter Scott wrote the oft-quoted lines :—

"Far in the bosom of the deep
O'er these wild shelves my watch I keep,
A ruddy gem of changeful light
Bound on the dusky brow of night;
The seaman bids my lustre hail,
And scorns to strike his tim'rous sail."

It would be impossible within our present limits to relate the history of all the famous lighthouses of more modern days, nor is it needful, for the story of one is very like the story of another, illustrating the same dangers, the same bravery, the same endurance. Else we might give an account of the raising of such sturdy structures as that which gives forth its guiding beams from the Wolf Rock, off the Land's End ; the wild and lonely tower of the North Unst ; the Skerrymore, which cost over £90,000; the new lighthouse at Bishop Rock, off Scilly; the Fastnet, off Cape Clear; the Dhuhearlack, the Chickens Rock, the Needles, and others. Upon these the best engineering skill of modern days has been employed, and they are, almost without exception, works of beauty as well as of impregnable solidity. It should be added that the cost of keeping up the lighthouses, lightships, and sound signal stations of the United Kingdom is £353,000 per annum, and that the cost of new works in connection therewith averages about £75,000 yearly.

Within the last half century the number of lighthouses has been quadrupled. Recent statistics give the total number of lighthouses in the world as 3,301, made up as follows: United States, 632; United Kingdom, 556;

Canada, 451; France, 291; Scandinavia, 207; Spain and Portugal, 151; Italy, 145; Belgium and Holland, 115; Greece and Turkey, 114; West Indies, 110; Australia, 103; Russia, 102; Germany, 25.

These thousands of lights, throwing their friendly rays across the darkness of the seas by night, and forming welcome landmarks by day, are amongst the most important agents in the saving of the lives of those whose business is with the mighty waters.

CHAPTER IV.

THE STORY OF THE LIGHTHOUSES (*continued*).

In the matter of the fitting up and illumination of our lighthouses many important improvements have been made in recent times. We have already indicated the leading features of the constructive changes effected, and have made allusion to the more primitive systems of illumination; it will now be necessary to say something regarding the principles of lighting which modern science has introduced into our lighthouse organization.

On the beacon towers planted sparsely over the headlands of our coasts in ancient days they used to burn wood, and at a later period coal was substituted as an illuminant. But these lights were of a fluctuating character, and liable to be greatly affected by the weather. After a time, coal gave way to candles, and it was with these that our great lighthouses continued to be lighted until near the end of the eighteenth century, when oil superseded candles. Since then gas and electricity have come to the aid of the lighthouse-keeper, and the rays which can now be thrown out across the face of the waters penetrate over many miles of distance. Oil lamps were in use at Cordouan and other French lighthouses about 1780, but the lamps were so unsatisfactory that a return to the older system was loudly called for. By the adoption of Argand's improvement, however, and an arrangement of reflectors introduced by other inventors, a much better illuminating power was obtained. At Dieppe, Borda had a small revolving apparatus of five parabolic reflectors made in 1784, and this method of lighting was speedily adopted by all the maritime powers. It was known as the Catoptric System, and was for very many years exclusively employed on the coast of England. Catoptric lights are of nine separate classes—fixed, revolving white, revolving red and white, revolving red with two whites, revolving white with two reds, flashing, intermittent, doubled fixed lights, and double revolving white lights. We cannot do better than quote Mr. Alan Stevenson's description of these different varieties, in a slightly condensed form.

The *fixed* exhibits a regular and steady appearance, and is not subject to any change; and the reflectors employed are smaller than those required for revolving lights. This is necessary, in order that they may be ranged round the circular frame, with their axes so inclined as to admit of their illuminating every point of the horizon.

The *revolving light* is produced by the revolution of a three or four-sided frame, having large reflectors grouped on each side, with their axes parallel; and as the revolution exhibits once a minute, or once in two minutes, a light gradually increasing to the maximum, and then just as gradually decreasing to total darkness, its effect is remarkably impressive.

The *revolving red and white* is obtained by the revolution of a frame whose different sides present red and white lights, and exhibit the following succession:—two white lights after one red, or two red lights after one white.

The *flashing light* is effected in the same manner as the revolving, but, owing to a different construction of the frame, the reflectors on each of the eight sides are arranged with their rims or faces in one vertical plane, and their axes in a line inclined to the perpendicular —a disposition of the mirrors which, together with the greater quickness of the revolution, showing a flash once in five seconds of time, produces an impressive effect, wholly different from that of a revolving light, and presenting the appearance of an alternate rising and sinking illumination. The brightest and darkest periods being but momentary, this light is also characterized by a rapid succession of bright flashes; whence its name.

The *intermittent light* is distinguished by bursting suddenly into view and continuing steady for a short time, after which it is rapidly eclipsed for half a minute. This is due to the perpendicular motion of circular shades in front of the reflectors, by which the light is alternately revealed and hidden.

The *double lights*, which are seldom used except where exists a necessity for a *leading* line, as a guide for taking a channel or avoiding some danger, are generally exhibited from two towers, one of which is higher than the other.

The Catoptric principle has, however, of late years been confined almost exclusively to revolving lights; what is known as the Dioptric system having been largely adopted for fixed lights. This method is chiefly associated with the name of Fresnel, whose investigations on the subject of optical science were attended with so much success in the early years of the present century. Fresnel proceeded upon the principles of refraction. He employed lenses to intercept and refract the rays emitted by the lamp. As subsequently improved, the Fresnel lamp contained four concentric burners, which were protected from the great heat produced by their own combined flames by a superabundant supply of oil. A clockwork movement keeps the oil in a constant overflow at the wicks, the combustion being supported by fresh currents of air produced by a tall chimney-tube. Five and six-wick burners have been adopted at some lighthouses more recently, the value of a light given by a six-wick burner being said to be equal to that of 722 sperm candles. Sir James Douglass has introduced a seven-wick burner, one advantage of these large burners being that when the weather is clear some of the inner rings of flame can be turned down for economy's sake. A six-wick flame presents a diameter at its broadest part of five inches, and maintains an average height of six inches.

Oil forms the source of light at the principal portion of the lighthouses round the British coasts. Up to 1846 the oil employed was that obtained from the sperm whale, and was very costly. This was superseded, in the year named, by vegetable oils, but latterly paraffin and petroleum have come largely into use, their more dangerous properties having been to a certain extent eliminated. Paraffin is less than half the price of colza (vegetable) oil, moreover, and is an equally powerful illuminant. Once a year the supply of oil is replenished, being stored in immense iron cisterns, in some cases not less than 3,000 gallons requiring to be provided. A single six-wick burner consumes about 1,750 gallons per year. Mr. E. Price Edwards, in his recent work on "Our Sea-Marks," points out the advantages oil lamps possess over other illuminants. "Oil can be conveniently transported and safely stored," he says, "and the certainty and simplicity of its action are great recommendations. The lamps are easily manipulated by the keepers, and if paraffin be used it is the cheapest kind of illumination available. At present oil is the only illuminating agent which can be used at a rock lighthouse. At the Eddystone two-six-wick burners, one placed about six feet above the other, are employed, one light only being used for clear weather, and two lights when the atmosphere is misty or foggy."

Gas was slow in making its way to the lighthouse lantern. Not before the year 1865 was any practicable scheme for utilizing this illuminant for lighthouses put forward. Mr. J. R. Wigham, of Dublin, introduced a special gas-burner in that year, consisting of five concentric rings of gas jets, the innermost ring having 28, the next 48, the next 68, the next 88, and the outermost 108 jets, the diameters of each ring being respectively 4, 6½, 8½, 9½, and 11 inches. The initial experiment with Mr. Wigham's burner was made at the Howth Bailey lighthouse, near Dublin, and was afterwards adopted at several other lighthouses, proving quite as effective as oil as an illuminant, though not any cheaper. "It may be beaten in point of cheapness by mineral oil," writes Dr. Tyndall, "but in point of handiness, distinctiveness, and power of variability to meet the changes of the weather, it will maintain its superiority over all oils."

The electric light has also been utilized to some extent as a lighthouse illuminant. Experiments were made at the South Foreland lighthouse in 1858 with Holmes's magneto-electric machine, which, Faraday maintained, "practically established the fitness and sufficiency of the magneto-electric light for lighthouse purposes, as far as its nature and management are concerned." The electric system, however, may still be considered under its trial as far as regards its adaptability to this use. In 1862 the electric light was placed in the Dungeness lighthouse, and continued to burn there until 1874, when the old oil light was again resorted to. The lighthouse at Souter point was illuminated with an improved electric light in 1871, and has ever since shed its brilliance across the treacherous entrance to the Tyne. In the year following it was permanently established at the two lighthouses at the South Foreland; and in 1877 the dynamo-electric machines introduced by Messrs. Siemens had their light-producing powers demonstrated at the Lizard Point lighthouses. It may be that in course of time the system of electric lighting will supersede all others for lighthouses, but at present the expense of production forms a great drawback; while some authorities are inclined to think it less generally effective than oil or gas, notwithstanding its greater brilliance. Mr. Price says, "The electric light is very beautiful as a lighthouse illuminant; there is nothing can compare with its magnificent effects on a dark night. But opinions are still divided as to its real value at all times. Mariners have not yet fully learned how to accommodate themselves to its dazzling brilliancy, and complain at times of its bewildering influence; moreover, they are not yet fully assured as to its superior efficiency in thick weather; but, on the other hand, who can be more glad than the weather-tossed seaman at sighting its glorious light or luminous glare at its extremest range?" But whatever may be the ultimate practical judgment of those who are most concerned, it will be generally agreed that no light has ever equalled it for distinctiveness of character or beauty of appearance, and that the chief complaint which can be made against it is that under ordinary circumstances it is, if anything, too good for the purpose. The Board of Trade and the Trinity House have concerned themselves considerably of late with fresh experiments in connection with lighthouse illumination, and it is to be hoped that before long a system of lighting will have been arrived at upon which the whole of the lighthouse authorities may agree.

The provision for enclosing, protecting, and projecting the light within the lighthouse tower has received much attention on the part of men of science during the past two or three decades. The lantern forms an enclosure of glass, varying in diameter from two to six feet, according to the importance of the light. This glass hive, as it has been called, consists of a dome, a central belt, and a lower belt; the dome and lower belt being composed of circular rows of totally reflecting prisms, and the central belt comprising a series of lenses which gather up all the rays falling upon their inner surfaces, and divert them, so that they issue in parallel lines from the other side. This is the arrangement for a fixed light; in the case of a revolving light the hive is divided into vertical segments, like the sections of an orange, the incident rays being condensed so as to yield separate beams. In the same way the system is varied to meet the requirements of other descriptions of lights.

The lantern itself is usually of cylindrical form, surmounted with a dome or conical roof. The best and stoutest plate glass is used in the glazing, and is over a quarter of an inch in thickness, for not only has it to defy the force of the wind and storm, and the attacks of flying shingle, but, in the darkness of night, the sea-birds, attracted to the light like so many moths, dash themselves furiously against the glass, and fall dead or wounded on the floor of the external gallery.

Having thus briefly sketched what may be termed the scientific aspects of the lighthouse system, we may touch upon the more romantic side of it—the lighthouse service. This service is not one upon which a person of a frivolous disposition would be likely to enter. It is a service in which many of man's nobler qualities are called forth; a service requiring a high appreciation of, and complete obedience to, duty and discipline; demanding the exercise of great fortitude, self-denial, and patience; and not to be accepted without the strongest sense of responsibility. In the olden time a lighthouse-keeper was generally regarded as a sort of sea-hermit, one who loved not his fellow-men, but betook himself to the lonely ledges of the ocean from motives of melancholy seclusion. Stories of dark deeds and mysterious tragedies have often been told with regard to these watchers of the deep; but, for the most part, the men who have given their lives to the duties of the lighthouse tower have been as remarkable for their fidelity as they have been distinguished for their bravery.

In no branch of the public service is a more vigilant supervision exercised than in our lighthouse administration. The keepers are a specially trained set of men, and very carefully selected. No man is taken into the service over the age of twenty-eight, and he is not permitted to take upon himself the actual charge of a lighthouse until he has spent a year or two in learning all that there is to learn respecting the feeding, trimming, and management of the various kinds of lamps, and until he has passed through a course of experience at several lighthouses. At the end of his term of probation, if he has proved himself worthy and efficient, he is promoted to the post of assistant-keeper, and after a service of several years in this capacity, may at length find himself appointed to the position of chief keeper.

At a rock lighthouse four keepers are the complement, three being always on duty, while one takes his holiday on shore. Each keeper has to remain on duty for two consecutive months at a time, and then he has his month on shore, thus having four months of rest and relaxation on land during each year. At least, these are the prescribed regulations, but sometimes the weather prevents his going or returning at the stated time, and he is compelled to wait the pleasure of the elements. From sunset till sunrise the lamps have to be kept burning, bright and clear; no matter how the tempest may howl around him, or how the waves may shake the foundations of the tower, that is a duty that must be performed; it will admit of no neglect, for it is upon the steady presence of the lighthouse flame that the storm-tossed mariner has to rest his hope. That there are long stretches of monotonous existence for the three guardians of the light, cut off, as they are, from all contact with the everyday world and its excitements, there can be no doubt; but even when the sea is calm and reposeful, when "the stately ships go on to their havens under the hill" in peaceful security, and when the stillness and vacancy of unlimited space lies unbroken before them, they have their diversions. At low water they may perchance get down to the rocks for a little fishing, or a seal may put in an appearance, and invite them to attempt its capture; or the birds may seek temporary companionship with them. But these intervals of quietude seldom last long. As a rule, the position of the lighthouse is one where the tempest seems to be almost eternal. The elemental strife is never altogether absent, varying only in degree from the ordinary churning, dashing, and leaping of the restless waves to the utmost limit of destructive fury, when ships are to be seen breaking to pieces on the cruel rocks, and the shrieks of the drowning mingle with the voices of the storm. Then is the time when the lighthouse-keeper feels the full terror of his position, and realizes the dignity and beneficence of his duty. How nobly that duty is sometimes performed, and at what fearful risk, the records of our lighthouse history abundantly testify. The labours of the keepers, however, are by no means restricted to the trimming of the lamps. Daily weather reports have to be made up, daily accounts to be kept of the rate of consumption of oil or other stores, and a constant look-out has to be maintained.

With regard to shore lighthouses, two keepers only are necessary, who perform continuous duty without relief. At these stations something like the ordinary comforts of domestic life can be enjoyed, and as most of the men at such places are married, and can have their families with them, they do not feel any of the privations which attend the life of the occupants of the more lonely rock towers. The conditions of service are varied at stations where the electric light or gas is used, a resident engineer being a necessity in one case, and a keeper with special knowledge of gas-making being required in the other. For these special posts there is a special rate of remuneration; but, in the ordinary way, a principal keeper receives £72 a year, and is supplied with uniform clothing, a comfortably-furnished house, fuel and lights, and all necessary appliances and stores. But the stern demands of duty are always before them; from this there can be no departure. The following is amongst the "Regulations for the Lighthouse Service": "The keepers, both principal and assistant, are enjoined never to allow any interests, whether private or otherwise, to interfere with the discharge of their public duties, the importance of which to the safety of navigation cannot be overrated; and they are cautioned that their retention or promotion in the service depends upon their strict obedience to orders, and upon their adherence to the rules laid down for their guidance; on the exercise of constant habits of cleanliness and good order in their own persons and that of their families, as well as in every part of the lighthouse establishment and premises; and they are warned that any breach of good conduct, temperance, or morality, or the use of bad language, will render them liable to instant dismissal or other punishment, or, on the part of any of their families, to their exclusion from the Corporation's premises."

The men who have been engaged on this service have numbered amongst them many of heroic mould, and in some instances the members of their families have done deeds of daring that are worthy of being enshrined with the brightest stories of bravery in our sea-annals. Who does not remember the story of Grace Darling, and her splendid achievement of fifty years ago? On a dark and tempestuous night in September, 1838, the Hull steamer *Forfarshire* struck on a hidden reef called the Harcars, near the Longstone lighthouse, off the coast of Northumberland, having on board sixty-three persons, including passengers and crew. The signals of distress were observed by the occupants of the lighthouse, William Darling, and his daughter Grace, but the sea was in such a fury that the keeper could not possibly pull his boat through the waves to the ship's assistance. His daughter, with noble courage, offered to enter the boat with him. She sprang into the skiff, and in another moment the two were rowing with all their strength towards the wreck. Their peril was great; at every instant the waves threatened to engulph them; but still they toiled through the foam with unflagging vigour, and after much difficulty reached the ship and succeeded in rescuing nine persons, with whom they contrived to regain the lighthouse. When, a few years afterwards, Grace Darling was buried in the old chapel on Holy Island, Wordsworth supplied a fitting tribute to her memory:—

> "The maiden gentle, yet at duty's call
> Firm and unflinching, as the lighthouse reared
> On the island-rock, her lonely dwelling-place;
> Or like the invisible rock itself, that braves,
> Age after age, the hostile elements,
> As when it guarded holy Cuthbert's cell."

There are not many instances of lighthouse-keepers having had to face other dangers than those of the storm, but a strange story is told of an incident that happened to the keeper of the Ship Shoal Station lighthouse, on the Gulf of Mexico, in 1886. The tale will be best told in the words of Third-Assistant-Keeper Leach. He said:—"I was third and Mr. Dunn was principal keeper of the lighthouse. We had started the first and second assistant-keepers up the Atchafalaya bayou for provisions. They didn't come back, and after waiting five days for their return—the distance was only about fifty miles—we concluded that something serious had happened to them. The morning of the fifth day, while we were staring outside, we noticed a boat becalmed to the southward, and on examination we came to the conclusion that it was the missing boat belonging to our station. So I took the dingy and pulled out to her. On getting alongside I found in her only one man, and he was a stranger. I asked him where he was going with our boat. He said he had bought her of three men near Morgan city for 100 dollars. I told him our first and second assistant-keepers had gone up the bay in her; that we hadn't seen them since, and that I proposed to take him to the station. He made no resistance. For three days we fed and watched him, hearing nothing from the missing keepers. The fourth night Dunn was in the watch-room and I lay asleep below in my own room. I was awakened by a terrible pain in my head and found myself bleeding and the stranger standing over me with a hatchet, giving it to me as fast as he could. I yelled 'Murder!' jumped up, called to Dunn to come down and help, and had no sooner got the words out of my mouth than the stranger out with a revolver and began firing. Three balls struck me and I fell in a faint. Dunn in the meantime had hurried down and armed himself, but when he got to the foot of the stairway all was quiet and dark in my room and he could not hear anything. He crept cautiously into the small room where the small lamps were kept and past a skylight that caught the gleam of the big lantern. The stranger was watching for him and banged at him through my window, hitting him in the right shoulder. Dunn fired back into the darkness in the direction of the flash and the stranger shot him twice more, again in the right shoulder and in the right side. Dunn fell over, but got up at once, and just then I came to and called him. We heard nothing more of the stranger for some minutes, and then discovered that he had gone aloft into the watch-room. We barricaded the stairway, covered the skylight, and then turned to estimate damages. I was ready to faint again from loss of blood. Half my face was gone, just as you see it, and I had three pistol wounds. Poor Dunn was suffering principally from the two bullet wounds in his shoulder. Each of us had to use one left hand in binding up as best we could each other's wounds. The next day we took our prisoner to Morgan City and he was lodged in gaol."

It should be mentioned that the lighthouse serves a further purpose than that of showing a light to the mariner by night. In the daytime these erections are capable of identification by the shape and colour of the tower and the nature of their surroundings, and at night they show a distinctiveness of light which serves to indicate to the seaman its position. We have already pointed out the leading varieties of these distinctive lights, and a mariner is able, with the aid of his lighthouse chart, to ascertain pretty accurately how his ship stands when near the coast with relation to the particular point at which he is aiming, for no two lights of the same description are placed near to one another unless they are quite close and intended to be used together.

In connection with this subject it is necessary that our lightship service should be particularized. The special use of lightships is adequately set forth in the following description, taken from "Our Sea-Marks":—"It is obviously impossible that lighthouses on the mainland can in all cases be made serviceable in directing vessels how to thread their way through the intricacies of narrow channels running in all directions, and distant perhaps fifteen, twenty, or thirty miles from the coast. Something more is necessary to aid the mariner when he approaches the belt of sea immediately surrounding our islands; directions must be more definite, and the marks brought closer to the points or dangers required to be indicated. To meet these requirements, lightships or floating lights were established."

The first lightship was placed at the Nore, at the entrance of the Thames, in 1731; and in 1736 another floating light was established on the Dudgeon Shoal, at the entrance of the Wash. Fifty years elapsed before the system was extended, and in 1788 a lightship was moored on the Owers Shoal, off the South Coast. At Newarp Sand, off the Norfolk Coast, a floating light was placed in 1790; and in 1795 another was moored to the north-east of the Goodwin Sands. From that time the number of such lights has been gradually increased, until now there are some sixty lightships placed as signals of warning around the coasts of England and Ireland, though by reason of the general absence of sandbanks on the Scottish coasts there are none at all employed in those regions. The English light-vessels are painted red, the Irish black; and by day a large wooden globe is displayed at the masthead, while by night the lantern is hoisted, which contains a number of Argand lamps and reflectors, the lamps employed on different lightships varying from nine to as many as twenty-four. Only colza oil is considered safe for lightships, on account of the constant movement of the vessel. As in the case of lighthouses proper, the lights are varied so as to be distinguished from each other by night, and also from any neighbouring lighthouses. It may be mentioned, also, that the question of connecting lightships with the shore by means of submarine telegraphic communication has engaged no small amount of attention, and that this link of interchange will in all likelihood be established before very long.

It used to be no uncommon occurrence for lightships to break away from their moorings, but of late years such accidents have been very few, owing to the improved methods adopted for securing them. From 210 to 315 fathoms of chain cable made of iron one and a half inches in diameter are supplied to every lightship, which is connected with a mushroom or Martin's anchor of two tons weight resting on the sea-bed. Other methods of mooring are adopted, but this is the most usual.

The crew of a lightship consists of seven persons—the master, mate, six seamen, and three lamplighters, seven of these being on board at a time. Monthly visits are paid to the lightship by a steamer of the lighthouse service, exchanging the men and bringing fresh stores, the supply of which is always abundant. The master and mate spend alternate months afloat and ashore, and the rest of the men are relieved in the same way. Although the lightship service is by no means a lively occupation, much is done to relieve its monotony, the men having many duties to perform in the course of a day and a night, while most of them follow some handicraft during their spare hours on the vessel, and for those who enjoy the relaxation of reading there is always at command a good supply of books. The building and equipment of a lightship costs between £2,000 and £3,000, and it takes about £1,200 per annum to maintain it. The master receives £80 a year, and the men are paid fifty-five shillings a month.

The belt of illumination which the lighthouses and lightships throw around the coasts of all navigable seas is one of the best safeguards that the mariner possesses. It has grown with the advancement of civilization, and is now of such extent and power that it is the means of saving thousands of lives every year. When the mariner comes up from the under-world, after a long voyage, and approaches his native shore in the darkness of night, his first glimpse of the hospitable light that shines forth from the rocky headland sends a thrill of joy through his frame, and he murmurs a prayer of gratitude for its welcome, cheering presence. There are to-day upwards of three thousand of these beacons of guidance and warning scattered over the coasts of the world, of which Great Britain and her dependencies possess no fewer than 1,220.

CHAPTER V.

SEA-MARKS AND SIGNALS.

Of the minor aids to navigation and securities for the safety of sea-going lives, beacons, buoys, and signals form noteworthy features. Lighthouses and lightships may be regarded as safeguards against the greater perils of the coast-line; beacons and buoys as the warnings against the smaller dangers. Thanks to the effective surveys which have been made in later years, there is scarcely a rock or a sandbank at any point of approach over the whole extent of our shores that does not bear its distinguishing mark.

There are not fewer than 250 beacons on the coasts of Great Britain. In former times a beacon was always associated with a light; nowadays it is simply a warning mark. A large proportion of beacons are stonework erections placed at certain points of the land where it is expedient to indicate particular dangers at the entrance of harbours and other havens of safety. Then there are less substantial but equally serviceable beacon structures, constructed of iron or wood, some of which assume a cylindrical shape, while others consist of masts, poles, or perches. Each beacon has its special characteristic which can be easily read by the mariner, the distinctive mark being displayed at its summit in the form of a globe, diamond, cross, triangle, or otherwise. On the Scottish coasts there are several beacons which are lighted up at night, the best known of these being that which stands at the entrance of the anchorage in Stornoway Bay, Isle of Lewis, in the Hebrides. It is a conical beacon of cast iron, and on its summit a lantern has been fixed, which, although it contains no actual burning flame, nevertheless throws a welcome gleam of radiance over the water, serving all the purposes of a lighthouse. It is one of the advantages of a beacon that it costs little or nothing to maintain it in efficient working order; the first expense is, as a rule, the only expense. Nor is the beacon in Stornoway Bay an exception. The light that shines from the lantern of this beacon is a reflected light. On the neighbouring Isle of Lewis there exists a lighthouse, and from one of the lower windows of the tower a condensed beam of light is projected on to a mirror in the lantern, so placed as to reflect the rays on to an arrangement of prisms, the effect produced being that of an actual lamp. A similar light is in operation at Grangemouth in the river Forth, and at Ayr in the Firth of Clyde.

The buoy is one of the most familiar of our sea-marks. There are about 1,000 of these floating danger-indicators placed round the coasts of the United Kingdom. They consist of water-tight casks, spars, or blocks of wood, and are attached to the bottom by means of ropes or chains. Their object is to reveal to the mariner the position of hidden dangers. Although generally made of wood, in some cases sheet iron and gutta-percha have been used in their construction with good effect. They vary in size from six to thirteen feet in length, and at one time there existed many of still larger dimensions, some being as much as twenty feet long, but they have proved difficult of handling and have been replaced by smaller ones. Each buoy is supposed to tell its own story of what lies beneath. Hence there are many varieties of buoys. There are Conical buoys, which present the pointed top of a cone above the surface of the water, these being always what are called starboard-hand buoys. There are Can buoys, showing a flat top above the water, and invariably indicating the port-hand side of the entrance to the harbour, river, or estuary from the sea. There are Spherical buoys, having a domed top. These mark the ends of middle-grounds. Then we have the Pillar buoy, the Bell buoy, the Gas buoy, the Automatic Sounding buoy, the Spar buoy, each having its special significance. The Bell buoy, as its name implies, carries a bell, which gives forth its warning sound day and night by the heaving and setting of the billows. There is also a Whistling buoy, which is fitted with an apparatus that makes a peculiar whistling noise at certain stages of the tide or sea.

Buoys possess other distinguishing features besides those of shape. Colour plays an important part in their serviceability, although the colour varies in different countries. The entrance to a channel or a turning point is marked by a spiral buoy, with or without staff and globe, triangle, cage, &c. Single-coloured can buoys, black or red, mark the starboard side, and buoys of the same shape and colour, either checkered or vertically striped with white denote the port side. Globes are used on buoys on the starboard hand, and cages on the port. When a middle-ground exists in a channel, each end of it is marked by a buoy with horizontal white stripes. Wrecks are indicated by green buoys. All buoys have their names painted on them in conspicuous characters. The foregoing are the regulations concerning buoys in English waters. A slight variation is observed in Scotland. There, a ship coming from seaward leaves the red buoys on the starboard hand, and the black buoys on the port. Red and black buoys are placed on detached dangers, and may be passed on either side.

Many suggestions for improving the buoy service have been made during recent years, and it is not improbable that important changes will be introduced in these matters at no distant date. One proposal is that all the buoys round the coast shall be connected with electric wires, with the object of lighting them simultaneously by the electric light. Luminous paint has been tried upon buoys, but with rather disappointing results. Gas, however, as a buoy-illuminant has answered fairly well in the few instances where it has been tried. The body of the buoy is used as a receptacle for compressed gas, and a pipe connects the gas chamber with a burner enclosed in a small lantern at the top of the buoy. Several of these buoys have been employed with admirable effect, and there seems to be no reason why this project of the lighting of buoys should not be widely utilized.

Coming to the question of marine signals, we find ourselves confronted by a wonderfully ingenious system of communication between one ship and another, or between a ship and the shore. It is a system that has been long in reaching maturity, but in its present form may be considered very complete. Signals were in use in the early Greek and Persian fleets, and were made by means of the sails, certain interpretations being given to their position and state, whether furled, loosed, or partially secured. Shields held aloft in various positions, and bright gleaming fires, were made useful. No record of a code of signals is to be found in ancient writings. Night signals were invented about the same period as day codes. In 1420 Captain General Piero

Mozenigo, a Venetian, invented a system of flags with distinction in colours, giving to each galley of the fleet a pennant and flag. He also established the rule that a fire on the poop should signify "set mainsail"; two fires, "both the square sails"; three fires, "all plain sail"; four fires, "lay in the oars, and make all sail." Fleet signals, however, were not generally adopted before the middle of the seventeenth century.

To the Duke of York, afterwards James II., belongs the honour of first introducing in 1665 a signal code upon a regular system. The Papal code of 1614 prescribed that a pennant hoisted on the poop indicated "make sail," and to be dipped once for each sail to be set. A banner displayed amidships denoted "distress"; and one held up on the poop meant "form line of battle." In 1781 a Mr. McArthur, who had been secretary to Lord Howe, originated a code of thirteen flags. Each flag was known by a letter and number. This system was used by Nelson at the Battle of Trafalgar when he hoisted the famous motto, "England expects every man to do his duty."

Every ship has a name, which is distinctly written on its hull, but as that could not be read at any great distance, some means has to be devised of indicating or signalling the name in some other fashion. By an Act of Parliament, passed about thirty years ago, it was laid down that every English vessel, large and small, should bear a number as well as a name, and should keep to that number as long as its timbers held together. Indeed, its number lives after it, for after it has ceased to "plough the main" and been broken up, no other vessel is allowed to assume the number. Each number, with the name belonging to it, is recorded in a register kept by the Marine Department of the Board of Trade, or the Registrar of Shipping, and to correspond with this there is a code-book printed with each of these numbers opposite its proper name. By the aid of this code-book and four flags a captain can not only tell the name of his ship to a passing vessel, but indulge in an extended conversation on other subjects. According to their respective shapes, colours, and devices, and to the mode in which they are arranged, the four flags denote the four consonants N X L T, or K C D P, or S M G N, or Q H N R, or any other among tens of thousands of combinations, all of which have their easily found interpretation in the code-book. This code-book is packed with words, phrases, and sentences. Every word or phrase has a distinguishing number allotted to it. For example, 0196 is campaign; 0286, commissariat; 0472, famine; 0675, obstruction; 0761, ransom; 0795, rescue; 0813, retreat; 0916 temperature, and so on. For the purely conversational part of the code some five or six thousand short sentences are collected, comprising questions, answers, and remarks of the most useful kind. Amongst the sentences may be instanced such as the following: "Ship on fire," "Water-logged and abandoned," "Broke the shaft of steam-engine," "Ship in distress," "Short of provisions," "All hands at the pumps," "Prepare for a hurricane," "Will you take us in tow?" "Driven by stress of weather," "Send me an anchor and cable immediately," "Out of water—can you supply us?" "Can you accommodate a few passengers?" Every one of these sentences has its number and its group of consonants in the code-book, denoting what flags are to be hoisted; and so of the thousands of others.

It is in this manner that ships speak with each other at sea, and although, happily, the speaking is often a mere diversion, or to satisfy the promptings of curiosity, there are times of more serious interchange, when the passing of these word-symbols from ship to ship is a matter of life and death. This power of speech by flags enables a ship to make known to another vessel its needs and requirements, and often calls up assistance when it could not be as readily obtained by other means. Without this ability to specify by signal the special nature of a danger or a necessity, much time would be wasted and great uncertainty would prevail. Cases have been known where a barrel has been run up to the yardarm as a signal for water, a tablecloth has been displayed as an invitation to dinner, and kindred pleasantries have been indulged in by the facetious sailor; but, with the code-book at hand, any ordinary communication can be passed from ship to ship with the greatest facility.

By night, when the use of flags is impossible, the signalling is done by lanterns. Lamps are hung out with a general observance of the same system, modified to suit the altered circumstances, a name or sentence expressed by flags in the daytime, would, at night, be indicated by lamps similarly arranged. Bags, or pieces of red bunting, are kept at hand to cover one or more of the lamps so as to provide a permutation of white and red lights.

In the matter of general signals by night some regulations were put into force in 1846, and a further development took place in 1852. In the former year it was prescribed that all steamers should carry two lights; and in the latter year a rule was established for vessels to carry a red light on the port side, and a green light on the starboard side. In 1861 steamers were ordered to carry a white masthead light; and in 1864 the international rules were promulgated by which sailing vessels, steamers, vessels in tow, and pilot vessels were made distinguishable by their lights. These rules were revised in 1880, and additional lights were provided for vessels in distress, and for vessels engaged in different kinds of fishing.

Turning again to the more particular question of the protection of human life, it is necessary to refer to the great development which has taken place in recent years in connection with sound-signalling. In 1873 and 1874 a series of experiments and investigations was carried out, under the direction of Dr. Tyndall, who then held the post of scientific adviser to the Trinity House. The conclusions then arrived at are succinctly set forth in Dr. Tyndall's well-known work on "Sound." It was shown that neither rain, hail, snow or fog has any sensible power to obstruct sound; from which it was evident that at those times when a sound signal might be of especial service, the sound was not likely to be obstructed in its passage. The real obstructors of sound were demonstrated to be wind and acoustic clouds, the latter having nothing to do with ordinary clouds, fogs, or haze, but being liable to arise from air currents differently heated, or from air currents differently saturated with vapour, they often existing on days when the atmosphere is visually in a very transparent condition. It was established that a bright clear day is not necessarily the best for hearing distant sounds, and that on a day of dense fog it is more than probable that no obstruction is offered to the passage of sounds.

Various kinds of instruments are employed as coast fog-signals. Bell-signals have long been in use for this purpose, tradition connecting the famous Inch Cape rock with a warning sound of this description. "By east of the Isle of May," says an old writer, "twelve miles from all land, in the German Ocean, lies a great hidden rock, called Inch Cape, very dangerous for navigators, because it is overflowed every tide. It is reported in old times upon the saide rock there was a bell, fixed upon a tree or timber, which rang continually, being moved by the sea, giving notice to the saylers of the danger. This bell, or clocke, was put there and maintained by the Abbot of Aberbrothock; and, being taken down by a sea-pirate, a year thereafter he perished upon the same rock, with ship and goodes, in the righteous judgment of God."

In 1811 a bell signal was erected at Poolberg, in Ireland; in 1812 there was one placed on the Bell Rock, in Scotland; and as years went on many others were fixed at different places. Various improvements have latterly been made in the mechanism of these signals, the ringing being now generally produced by clockwork, the hammer or clapper alone being moved by machinery. The bells vary in weight from three to forty-five hundredweight. For long-distance signalling, however, bells are not very reliable.

Amongst the fog-signals in use on board ships the gong is entitled to mention. These instruments are struck with a padded stick, which stirs the gong into vigorous vibration, producing a distinctive sound, which there is no mistaking. Guns are also largely used for fog-signalling, and form one of the authorized signals of distress. Formerly, it was the custom to fire the fog-signal gun every fifteen minutes, but ten minutes now form the interval. Whistles and horns are more in favour, however, to-day as fog-warnings; but the instrument which is most generally adopted is the Siren, which is the most powerful of all fog-signals. The Siren was brought out by Messrs. Brown, of New York; and in 1874 this apparatus was experimented with in England, at the South Foreland lighthouse. It can be sounded either with steam or compressed air, made to pass through a fixed flat disc, fitted into the throat of a long cast-iron trumpet, connected with the steam or air-pipe. "This disc has twelve radial slits, and behind it is a rotating disc, with twelve similar slits, the rotation being effected by separate mechanism." The disc makes 2,400 rotations in a minute, and as there are twelve coincidences in a revolution, the number of puffs passing through it per minute is 28,800. The sound thus generated rises superior to all local noises. Since 1874 from twenty to thirty Sirens have been placed on the chief lighthouse stations on our coasts, and an almost equal number have been fixed on board lightships.

At first steam only was used for sounding the Siren, but the method now generally adopted is to sound the trumpet by compressed air produced by caloric engines, which is safer and more economical. Various improvements have recently been introduced in the construction of this signal, which now forms by far the best sound signal for use in a fog. A double-siren was patented by Messrs. Sautter, Lemonnier & Co., of Paris, the effect of which is to double the sound, producing two notes in the trumpet instead of one. Sir James N. Douglass, Mr. Slight, Professor F. H. Holmes, and others have also invented improved arrangements in connection with the instrument. The introduction of the Siren, indeed, marks one of the most effective developments in the direction of protection that recent years have given the mariner. By its aid a ship can continue its voyage through the densest fog in comparative safety.

Professor Bell, the inventor of the telephone, has recently made some very interesting experiments as to the conductivity of water, and has discovered that if a ship trails a long wire behind it in the sea, and that wire is attached to a "dynamo" on board the vessel, an extraordinary amount of electrical action is at once set up in the waves, producing a current strong enough to influence a telephone which may happen to come within that circle. It is said that with a wire five miles long, giving a diameter of circle of ten miles, those on board would be informed whenever anything approached within five miles. Although this idea has not yet been utilized, there is nothing to prevent its being adopted with such modifications as further experiment may suggest. The theory may at all events be accepted as an indication that science has by no means got to the end of its usefulness in regard to the protection of the mariner. As the laureate has it, "all the years invent," and the years to come will not be less prolific in devising new safeguards than the years that have fled have been. The official mind, however, is slow to grasp fresh developments, and is prone to accept the latest improvement as final. For instance, it was not long ago stated that the Board of Trade were not without a hope that "a limit might now be reached in which the whole of the lighthouse authorities might agree, as being the limit of illumination, beyond which no practical advantage could result to the navigator." Well might Dr. Tyndall castigate the writer of this obtuse paragraph as one who would like to say to science, "Thus far shalt thou go, and no farther." But scientific invention never rests, and although in the sea-marks and signals which we possess to-day we enjoy a measure of protection that could never have been dreamt of half a century ago, the probability is that improvements of no less importance will distinguish the progress of the next half century.

CHAPTER VI.

THE LIFEBOAT SERVICE AND ROCKET APPARATUS.

ENGLAND occupies the unique position of being the only country in which the most efficient life-saving organization is solely supported by voluntary aid. The Royal National Lifeboat Institution was founded in 1824, and with its development the history of the lifeboat service is closely identified. Lifeboats, of course, were of earlier origin, but until the foundation of the institution their usefulness was only co-extensive with individual generosity. The credit of inventing the lifeboat belongs to Lionel Lukin, a coach-builder of Long Acre, London, although a couple of tombstone inscriptions referring to other inventions dispute the fact. In the parish church of St. Hilda, South Shields, there is a stone "Sacred to the Memory of William Wouldhave, who died September 28, 1821, aged 70 years, clerk of this church, and Inventor of that valuable blessing to mankind, the Lifeboat"; while another similar record states that "Mr. Henry Greathead, a shrewd boat-builder at South Shields, has very generally been credited with designing and building the first lifeboat about the year 1789." As a matter of fact, Lukin, who had previously written a pamphlet entitled "The Invention, Principles, and Construction of Insubmergible Boats," patented his lifeboat on the 2nd of November, 1785. Its peculiarities were projecting gunwales and hollow cases, or double sides under them, as well as air-tight lockers or enclosures under the thwarts. These contrivances increased the buoyancy of the boat, and the air-tight cases under the gunwales, by their weight when raised above the surface of the sea, and their resistance when depressed beneath, greatly prevented rolling. The boat, however, was liable to be disabled by having the sides staved in. It was launched at Bamborough, and through the indifference of the Admiralty on the subject of saving life at sea, was the only lifeboat on the coast for several years.

A disaster which occurred in September, 1789, aroused public interest in the subject. The ship *Adventure*, of Newcastle, was stranded on the Herd Sands, on the south side of Tynemouth Haven, in the midst of most tremendous breakers, and all the crew dropped from the rigging one by one in the presence of thousands of spectators, not one of whom could be prevailed upon by any reward to venture out to her assistance in any boat or cobble of the ordinary construction. On this melancholy occasion the gentlemen of South Shields called meetings, with the result that premiums were offered for plans of a boat which should be the best calculated to brave the dangers of the sea, particularly of broken water. It was in the competition thus created that William Wouldhave and Henry Greathead came upon the scene. Greathead's invention secured the most favour, and he was instructed to build a boat at the expense of the committee. This boat had five thwarts, or seats for rowers, double banked, to be manned with ten oars. It was cased and lined with cork, which gave it the buoyancy to float and be serviceable though so damaged by hard knocks as to be almost in pieces—an accident, however, which the softness and elasticity of the cork was well calculated to prevent. Its efficiency having been demonstrated, the inventor received numerous orders to build lifeboats, and by the year 1804, when the Society of Arts voted Mr. Greathead their gold medal and fifty guineas, nearly 300 lives had been saved from vessels wrecked near the mouth of the Tyne alone. Before the end of 1803 he had built no fewer than 31 boats—5 for Scotland, 8 for foreign countries, and 18 for England. Parliament had previously voted the inventor £1,200, the Trinity House gave him £105, Lloyd's the same sum, and the Emperor of Russia made him a present of a diamond ring.

The interest that had been aroused, however, was destined in a short time to collapse, and the cause of the lifeboat did not gain ground, nor did the number of boats increase to the extent one would have naturally supposed. The reason probably was the characteristic suspicion of Englishmen with regard to anything "new-fangled;" added to which were several disasters to the lifeboats themselves, which led some people to think that the remedy was worse than the disease; and it was not until 1822 that the subject of the preservation of life from shipwreck on our coast was successfully championed. Sir William Hillary, Bart., manifested an heroic interest in rescuing life from the raging sea. He lived on the coast of the Isle of Man, and established a Sailor's Home at Douglas. During his life he assisted in saving more than 300 lives, and succeeded in stirring up public men and the nation generally. His efforts were consummated by the founding, in conjunction with Mr. Thomas Wilson, and Mr. George Hibbert, both Members of Parliament, of "The Royal National Institution for the Preservation of Life from Shipwreck," the objects of which were to be attained—(1.) By the stationing of lifeboats, fully equipped with all necessary gear and means of security to those who man them, and with transporting carriages on which they can be drawn by land to the neighbourhood of distant wrecks, and by the erection of suitable houses in which the same are kept. (2.) By the appointment of paid coxswains, who have charge of, and are held responsible for, the good order and efficiency of the boats, and by a quarterly exercise of the crew of each boat. (3.) By a liberal remuneration of all those who risk their lives in going to the aid of wrecked persons, whether in lifeboats or otherwise, and by the rewarding with the gold or silver medal of the institution such persons as encounter great personal risk in the saving of life. (4.) By the superintendence of an honorary committee of residents in each locality, who on their part undertake to collect locally what amount they are able of donations towards the first cost, and of annual contributions towards the permanent expenses of their several establishments.

We may profitably examine how this work is, and has been, carried out, by an analysis of the last Annual Report of the Institution—that for 1887. It is difficult to comprehend the true and realistic character of the work performed through the agency of the organization from the plain, simple, and almost prosaic language of this document. It is an unvarnished statement of noble work nobly performed, and honest effort heroically exerted. Including the twenty new lifeboats placed on the coast in the course of the year, the Institution possessed at the close of 1886, a fleet of two hundred and ninety-three lifeboats available for active service. These were called into requisition and launched on two hundred and eighty-six occasions, and were in addition taken out eight hundred times for inspection and practice. By their aid, six hundred lives were rescued from drowning, and thirty-three vessels wrecked or otherwise in distress were assisted and saved. The grand total of lives saved since the foundation of the Institution, and for which it has granted rewards, is 32,671. Thirteen silver medals, thirty-two binocular glasses, thirty-five votes of thanks on vellum, and £6,630 4s. 11d. in cash, including grants to the widows and orphans of lifeboat men drowned on duty, were awarded by the committee of 1886, for saving life, and a further sum of £5,285 15s. 3d. was paid to the coxswains and crews for exercising the boats. The total expenditure for the year amounted to £47,066 2s. 2d., while only £43,044 13s. 4d. was received in subscriptions, donations, and dividends. The demand for the beautiful aneroids, supplied by the Institution at one-third the retail price to fishermen and small coasters, is great; and there can be no doubt that the use of these valuable instruments has tended to diminish the loss of life along the coast.

During the forty years following Greathead's invention, numerous other lifeboats were introduced or proposed for introduction, but all of them were wanting in some or other of the requisite qualities, and it was not until a lamentable accident occurred to one of Greathead's boats, whereby twenty pilots were drowned, that inventive genius was effectively stimulated to achieve further efficiency. The Duke of Northumberland, in 1850, offered a prize for the best model of a lifeboat, and no fewer than 280 plans and models were sent in from various parts of the kingdom as well as from France, Holland, Germany, and America. About fifty of the best of these were exhibited at the Great Exhibition of 1851. The examining committee appointed by his Grace drew up a list of all the good qualities of a lifeboat, and noted down the rank of each of the 280 plans in reference to each quality; and then a summary of these partial results gave an aggregate result for each boat; which determined the amount of its claim to the place of honour. Tested in this way, the prize was awarded to Mr. Beeching, of Yarmouth. Nevertheless, it was considered that a better boat might still be produced, and therefore Mr. James Peake, assistant master shipwright in Her Majesty's Dockyard at Woolwich, and who was one of the Committee, designed a boat which comprised many of the features of the competitive boat; and added others suggested by his experience. This boat, gradually improved in later years, constituted the recognized English model; it was adopted to the exclusion of all others by the Lifeboat Institution, and many boats on the same construction were sent to Russia, Prussia, Spain, Portugal and the Colonies.

Mr. Peake's lifeboat is flat in the bottom, and provided at the ends and sides with air-tight chambers. Between the outer bottom and what may be called the floor or deck of the boat there is a space stuffed with cork and light hard wood. Were a rent therefore made in the outer covering the vessel would still float. A heavy iron keel keeps the boat straight, and by a proper adjustment of parts it is scarcely possible in the stormiest sea to turn a lifeboat upside down—should such a thing happen, the keel generally rectifies it. There have been of course painful exceptions to this, the most recent being the disasters that befell the Southport and St. Anne's lifeboats on the night of the 9th December, 1886. Both boats had gone out to the rescue of the crew of the barque *Mexico*, of Hamburg, and both were capsized, and twenty-seven of the twenty-nine brave fellows who manned them perished. An inquiry into the cause of the accidents was held by the Board of Trade in conjunction with the Royal National

Lifeboat Institution, the report of which was subsequently published. It appears that the Southport boat had reached a position a little ahead of the barque on her starboard bow, and was about to let go her anchor to veer down to the wreck when a heavy breaking sea struck her about four points on the bow, and instantly capsized her. The anchor at this time was in the act of being let go, and consequently fell overboard with about twelve feet of cable, two or three turns of the inboard part of which were round the bollard, which turns were probably washed off as soon as ever the boat capsized. The boat never righted, although there was evidence that she made several attempts to do so, but always fell back again. Her failure to right was doubtless occasioned by the anchor having been let go, and also to the number of men holding on round and under the boat, though (the Special Commissioners found) "the former of these two causes would probably be sufficient to account for the casualty, as was proved to have occurred on previous occasions."

With regard to the fate of the St. Anne's lifeboat, what happened to it is pure conjecture. She was known to have proceeded for about 500 yards under oars, and then to have made sail crossing the Salt House Bank. There was some evidence to show that two red lights, and other signals were seen about west-by-north from Southport, at a distance of two miles, and if these two red lights were distress signals from the lifeboat she had probably met with some casualty in that position. None of her crew, however, survived, and any opinion as to the cause of the disaster is of necessity hypothetical. The boat was found on the beach on the morning of the 10th of December, bottom up, and three bodies were found hanging on the thwarts with their heads downwards. In drifting ashore the boat must have capsized as soon as she got into shoal water, and it would then have been impossible for her to right again. Whether she capsized before this there was no evidence to show.

It is interesting in this connection to note with reference to the self-righting lifeboats which have been launched on service for the past thirty-two years, there have been five thousand launches and over twelve thousand lives have been saved. On these occasions there were only forty-one capsizes, twenty-three of which were unattended by any loss of life. In the remaining eighteen, eighty-eight lives were lost—seventy-six lifeboat men lost represented one in eight hundred and fifty of the men afloat in the lifeboats on service, and the capsizes one out of each hundred and twenty launches on service. In addition to this the boats were out for exercise fifteen thousand times during the same period of thirty-two years, with a loss of only eight lives.

The lifeboat therefore is entitled to be considered a triumph of naval architecture, while the service under the auspices of the Institution deserves the world-wide admiration accorded to it. At all the principal, and a number of minor ports, a lifeboat is kept ready for use, and a body of men are prepared to act on emergencies. The boats are kept in charge of paid coxswains, under the general superintendence of Local Honorary Committees of residents in the several localities. Each boat has its appointed coxswain at a salary of eight pounds, and an assistant at two pounds a year. The crew consists, in addition, of a bowman, and as many boatmen as the boat pulls oars. The members of the volunteer crews are mostly resident boatmen, fishermen, or coastguardmen. Anything like unseemly rivalry on the part of the crews has, of course, to be repressed, but it happens occasionally that the usual skilful men are not to be procured at the moment when the boat's services are required, some perhaps being ill, others at sea, or engaged in avocations at a distance; in such cases the first well-known oarsman who arrives at the scene of action, and secures a life-belt, has at once his claim acknowledged to a seat in the boat. It is remarkable to observe how unflinching and ceaseless has been the emulation of the men on these occasions, notwithstanding that it is manifest they will sometimes have to encounter frightful peril and exposure. On every occasion of going afloat to save life, the coxswain and each man of the crew receive alike from the funds of the Institution (whether successful or not) ten shillings if by day, and one pound if by night; and four shillings each for every time of going afloat for exercise. The rewards for saving life are increased on special occasions when unusual risk or exposure has been incurred. Besides pecuniary rewards the Society also grants its gold and silver medals, and thanks inscribed on vellum for gallant deeds by lifeboats and other means in saving life from wrecks along the coast.

With due and proper consideration for the safety of the crews the committee of the Institution recently decided to withdraw from their stations on the coast all self-righting boats that will not pass the new and more rigid code of tests which experience has shown to be necessary, and it is satisfactory to know that the watchful enterprise characterizing the practical management of the organization secures to it the benefit of every modern improvement in the matter of lifeboats. This fact was sufficiently demonstrated by the award to the Institution of the prize of £600 and a gold medal offered by the International Fisheries Exhibition of London in 1883 for the best coast lifeboat, and by the later circumstance that the Inventions Exhibition added nothing to the most approved life-saving appliances adopted by the National Institution. The new boats distributed to take the place of those withdrawn from duty or forwarded to strengthen the service at established stations, are all furnished with the latest improvements suggested by nautical science. The result of the experimental trials upon them were satisfactory, and the coxswains and crews almost unanimously expressed their satisfaction with the new craft, and their perfect confidence in their sea-going powers.

One boat—the one sent to St. Anne's after the disaster already referred to—was returued by the coxswain and the committee of the station, and the occurrence elicited the suggestion of a series of eight improvements by Mr. J. T. Morris of Broughton, Manchester, to which the *Times* gave special prominence in May, 1887. An outline of Mr. Morris's proposals must necessarily omit many particulars material to their appreciation, and incidentally must omit also a complete statement of their alleged merits. They relate, however, to problems of importance, which have been shown as still awaiting solution. Severally or collectively, Mr. Morris asserted his suggestions are readily applicable to lifeboats in use. In the first place, a lifeboat is given, when inverted, an excess of buoyancy on one side, as a means of increased righting power on the other. Within the boat on the starboard side and above the water-line, the capacity of the air chambers at bow and stern would be enlarged. At the same time, on the port side, dummy enlargements of equal weight would be open to the inlet and outlet of water. Thus it is calculated that the equilibrium, the symmetry and even wind resistance of the uninverted boat would be preserved as much as they are at present.

But in case of the boat being inverted, says the inventor, the one-sided enlargement of air-cases is made to leave with the inverted keel initially inclined over the vertical point to a point of more effectual leverage for righting. The possible effect of the forces of sea and storm is here suggestive of doubts, which the inventor met. The sum of his contention is that these forces can be made subservient to the repair of their own misdoing. Number two of the series of suggested improvements is a contrivance to anchor from the keel instead of the sternhead, transferring the strain from the highest point of the boat to the lowest, and lessening the liability to capsize. The third suggestion converts from a disadvantage to an advantage the downward pull of the anchor rope in case of inversion, so that the boat may be righted by an arrangement which automatically transfers the pull from the keel to the side. A pair of submerged bearers or webs hinged one on each side the keel, and having each an effective area of thirty square feet form the fourth suggested improvement, and the expectation is that top-heaviness must thus be counteracted and stability increased. But in case of inversion the bearers or webs, acted on by the wind, would aid righting. The fifth proposal of Mr. Morris is a pair of cavity sails, self-inflating, water-excluding, and storing a large reserve of buoyancy to lessen the chances of complete inversion. Each sail would have buoyancy equal to the boat's weight. An overhead air-case or "cavity canopy" exists for use alternately when the sails are not admissible. The following are the seventh and eighth improvements emanating from the inventor before-mentioned :—An arrangement applying to the crew as well as to the boat. Rings or hooks on each life-belt, answering to rings or hooks on the gunwale of the port side, enable the crew to attach themselves instantaneously on that side only of an inverted boat. Air-cases on the starboard side would prevent their attaching themselves there. Thus their weight when supporting themselves out of the water is excluded from the side where it would oppose the boat's righting, and is accumulated on the other side, here again converting a disadvantage to an advantage. The last suggestion is to prevent the crew being precipitated from the boat if it capsized, which is thus accomplished. The proposal is to suspend the thwarts and the crew upon them, rigidly from a pivoted axle, the length of the boat, and in the pivot of the axis on which the boat and canopy must revolve upon inversion. The added buoyancy from the canopy, says Mr. Morris, lifts that axis above the thwarts. Mr. Morris calculates that though the boat might capsize, it would be impossible to invert the seats or thwarts, these remaining, at all stages of inversion, some two feet above the water level, suspended from the pivoted axle.

In addition to the new and improved water ballast lifeboats which were ultimately sent to Southport and St. Anne's, the Institution have provided a second lifeboat for the former station, which is kept moored afloat at the end of the pier. It is a large sailing boat, of the self-righting type, 40 feet long and 10 feet wide, and is provided with a sliding keel. The Institution are increasing the number of their water-ballast boats as fast as their income will allow, and they are also constructing boats with drop keels, which will have greater stability. Owing to the increased weight of the fittings, however, and the consequent greater draught of the boats, they are not adapted for all stations.

The record of the lifeboat service could not be more appropriately closed than by reproducing an official letter from the Board of Trade to Sir Edward Birkbeck, Bart., M.P., the chairman of the Royal National Lifeboat Institution. A statement had appeared in several newspapers to the effect that the Board of Trade contemplated an inquiry into the efficiency of the service conducted by the Institution, whereupon the following communication was addressed to Sir Edward Birkbeck on behalf of Lord Stanley of Preston, the President of the Board of Trade.

"In reply to your letter Lord Stanley of Preston wishes me to inform you that the statement which has appeared in various newspapers to the effect that the President of the Board of Trade has promised his best consideration to the desirability of holding an official inquiry into the seaworthiness or otherwise of the lifeboats of the Lifeboat Institution is without foundation.

"Lord Stanley is aware that the Institution is giving the matter its most serious consideration, and he has offered to place at its disposal any official assistance that it may require.

"I am to add that representations have been made to the Board of Trade as to the desirability of holding an official inquiry, but as Lord Stanley believes that the Institution is in full agreement with the Board of Trade in the matter, he does not think that any occasion for such an inquiry has arisen."

In the Report of the Institution already quoted, it is made known that the committee have offered a gold and silver medal for drawings or models of a mechanically-propelled lifeboat best adapted to meet the conditions under which lifeboats are called upon to perform their work; also a gold and silver medal for models or drawings of a propelling power suitable for the relf-righting boats of the Institution.

An important feature in connection with the lifeboat service is the development of telegraphic communication with the lightships. In 1885 efforts were made to connect the sunk lightship off the coast of Essex with the shore at Walton-on-the-Naze, a distance of nine miles. The efforts were crowned with success in the following year; but not until the Telegraph Construction and Maintenance Company had devoted their skill and energy to bringing the work to a successful issue. "We look upon the completion of this work," said the official organ of the National Institution, "as a very valuable advance in the measures for saving life from shipwreck, because it causes more speedy and more exact information respecting the actual site of any casualty, than it is possible to give by the present system of guns and rockets, or flags in the daytime for summoning lifeboats to the assistance of vessels in distress."

Next to the lifeboat service the rocket and mortar apparatus for saving life from shipwrecks holds a prominent place as one of the important and successful means by which shipwrecked persons are rescued on our shores. Wrecks often occur in positions inaccessible to a lifeboat, as, for instance, on a rocky beach, or at a great distance from lifeboat stations. In such emergencies the rocket is alone available, and it is worked by men of the Coastguard, with the help in some cases of Volunteer Life Brigades and Companies. To the late Captain Manby the country is mainly indebted for this life-saving apparatus. When he was stationed at Yarmouth in the early part of the century, he devoted much time and labour to the creation and perfecting of the invention, which, with some improvements in detail, is, as now used, substantially the same as he left it. Previous to Captain Manby, however, in 1791, the idea of throwing a rope from a wreck to the shore by means of a shell from a mortar had occurred to Sergeant Bell of the Royal Artillery, and by a singular coincidence to a Frenchman named La Fire. Both made successful experiments with their apparatus. In the same year (1807) that Captain Manby introduced his mortar, Mr. Trengrouse, of Helston, in Cornwall, proposed a hand and lead line as a means of communicating with vessels in distress. The Board of Trade took over the control and management of the rocket apparatus and stations two years after the death of Captain Manby (Nov. 18th, 1854), who during his life had the gratification of saving more than one thousand lives, and of receiving grants in acknowledgment of the good service rendered by his invention.

The most important change or "development" of Manby's invention was the substitution of Boxer's rocket for the mortar and shell used by Manby, which were liable to many objections. The peculiar characteristic of Colonel Boxer's invention is the combination of two rockets in one case, one being a continuation of the other, so that after the first compartment has carried the machine to its full elevation, the second gives it an additional impetus, whereby a great increase of range is obtained. In all cases when the apparatus is used two men are equipped in life-belts with life-lines attached, whose duty it is to go into the surf to rescue any that may have been washed overboard from the wreck. The apparatus itself is under the charge of the Coastguard at the different stations, and the chief officer present has the power to compel owners of horses to lend them for use in cases of shipwreck, and to order all persons present to assist in any way he may require. Unskilled assistance, however, is of little service, especially at night, a fact sufficiently apparent from a glance at the precise and very minute drill—very much resembling gun-drill—which it is Considered necessary to practise in order to secure the working of the apparatus with rapidity and success. The coastguard are seldom present in sufficient numbers to act by themselves, and sometimes wrecks occur simultaneously, to more than one of which it would be impossible for them to attend. The need of skilled and organized assistance was never more painfully apparent than at the wreck at the mouth of the Tyne of the *Stanley*, passenger steamship between Aberdeen and Newcastle, in November 1864, by which twenty-six persons perished after many hours of terrible agony. The fearful scenes of that night determined some gentlemen who had been helpless witnesses of them to take care that there, at least, for the future trained and efficient help should never be wanting. As a result of the movement then started the Tynemouth Volunteer Life Brigade was originated, and it has served as the pattern for a couple of hundred brigades and companies at different places along our coasts, whilst it is still regarded as the chief, as well as parent of all existing brigades.

The dangers and hardships to which men expose themselves in working the rocket apparatus are not equal to those incurred by the crews of lifeboats, but still they are far from inconsiderable, and in some cases have proved fatal.

Life-saving services in other countries are generally very efficient. That of the United States is chief among the lifeboat societies of other nations, both as regards the extent of coast embraced, and the amount of work done. There are several noteworthy points of difference between it and the service of England. In the first place, the whole, or nearly the whole of its support is provided for by regular grants from Congress; and, secondly, besides protecting its vast extent of sea-board, it has to provide for the shores of its great lakes, or freshwater seas. Moreover, the uninhabited condition of the American coasts necessitates the constant employment of surfmen for the express purpose of looking out for vessels in distress and manning the surf boats. It also necessitates the erection of houses of refuge, with an adequate commissariat. The history of the "United States Life-Saving Service" dates from 1848, although it was not until 1871 that the present effective system was organized.

In France the "Society for Saving Life from Shipwreck" is modelled on the basis of the English system. It was founded in 1865, and has done and is doing good and increasing service in the saving of life and property. In the same year Germany inaugurated a similar organization, although previous to that time several private societies for saving life from shipwreck existed in the chief seaports of the North Sea and the Baltic. These, however, have been absorbed in the larger associations, of which the Emperor William is the chief patron.

Russia, Italy and Spain have each their lifeboat societies or organizations, formed, more or less, on the basis of the National Lifeboat Institution of Great Britain.

There is a difference between the appliances in use in some foreign countries, and those which have found most favour in England. For instance, heavy boats are unsuitable to the flat shores of the Atlantic coast, where the boats chiefly in use are surf boats, incapable of self-righting, and liable to be swamped. The Americans, too, prefer the mortar to the rocket in projecting a line over a stranded vessel, and, in addition to the travelling life buoy, they use a metallic car—very much in appearance like a covered boat—which can hold three or four persons, who enter it by a sort of manhole, are shut in and drawn ashore in safety, even though overturned by the surf. The French boats are principally modelled after the English; but the gun is preferred to the rocket in connection with the life-saving apparatus. In Germany the heavy self-righting and self-emptying boats of England have been found unsuitable to the thinly-peopled and flat sandy beaches of the Fatherland, and lighter and shallower boats have therefore been adopted.

Although England was the pioneer of this humane service, and led the countries of Europe by a period of about forty years, yet there are some things in connection with the preservation of life which she would do well to copy from our neighbours across the Silver Streak. The French Society accomplishes much good indirectly by its influence. It has been instrumental in bringing about this result, that among the qualifications for a captain's certificate in the French mercantile marine a thorough knowledge in detail of the means of saving life from shipwreck is required. It has also, by its unremitting labours, extended the usefulness and reduced the cost of the gun and rocket apparatus, besides securing the supply of one of them to every ship in the French Navy.

PART II.

PROTECTION AGAINST NATURAL VISITATIONS.

PROTECTION AGAINST NATURAL VISITATIONS.

CHAPTER VII.

DEFYING THE LIGHTNING.

It is apart from our purpose to investigate the natural phenomena by which electricity is engendered in the atmosphere. Every one is familiar with the clouds of ominous presage that form the advance-guard of the thunderstorm—those dark, ragged masses of vapour which envelope the earth in shadow, and seem the embodiment of rage and fury. Not less familiar is the rush of hot wind which forces opposing elements into collision, and startles the lightnings into action. When once the shafts of flame have been set in motion, however, it behoves the hapless dweller beneath to bring into play all the protective resources at his command in order to ward off the destructive power that lives in every flash; and, it is some satisfaction to know that science and invention have not been altogether unsuccessful in coping with this natural visitation.

Lightning is of three kinds—forked, sheet, and spherical. Forked lightning is the most destructive, for though its flashes are generally slender white tongues of flame, these are often divided into three or more branches, each one of which is of deadly effect. Sheet lightning is comparatively harmless, and has neither the swiftness nor the whiteness of the forked kind. Spherical lightnings are what are commonly called thunderbolts, and consist of globes of fire which descend to earth, and often inflict great damage.

The power of the electric fluid is tremendous, irresistible. It tears trees up by the roots, hurls large masses of rock hither and thither with the utmost ease, crumbles roofs and walls to dust, and kills and maims human beings with instantaneous rapidity. Still stranger things are done by it in the working of physical transformations. In attacking combustible bodies it sometimes carbonizes or burns them, and in its contact with living creatures often affects the senses or produces or removes afflictions. A touch of lightning has frequently deprived persons of sight and hearing, or stricken them with paralysis or apoplexy; while, on the other hand, there are instances of defective vitality being restored by the electric current. It is recorded that a man named Donaldson, who had been deaf for twenty years, had his hearing restored by a flash of lightning; and that a clergyman, hopelessly afflicted with palsy, was completely cured by an electric shock which passed through his room in the night-time.

It is only in recent times that the possibility of coping with the lightnings has been realized. In ancient times nothing seems to have been done by way of safeguard, except so far as it could be done by the avoidance of places and objects especially liable to electrical assault. The annals of the past are full of stories of death and disaster from lightning. During a storm at the village of Chateauneuf les Moustiers, in the department of the Basses-Alpes, nine people were killed and eighty-two wounded by lightning in the village church while the service was in progress. In 1769 the electric current made its way into a powder magazine at Brescia, and the explosion destroyed a large portion of the town and killed over three thousand people.

Another time, while an audience of some six hundred persons were watching a performance in a Venetian theatre, the lightning cut its way into the place with such force that it put out the lights, killed several persons, scorched others, melted earrings and watch-cases, and wrought destruction in all parts of the house. Later, the town of Reichenbach was fired by the electric current, and the inhabitants had the greatest difficulty in escaping into the country, and a regiment of cavalry quartered in the town were unable to save any portion of their baggage. Happily, the instances of wholesale destruction by lightning are not very numerous, but cases of individual fatalities are many. Every summer increases the list, for, much as has been done to bring the lightnings into subjection, they still find their victims, and continue their work of destruction. There is hardly a country churchyard that does not contain its epitaph to the memory of some worthy soul whose career was cut short by an electric visitation. One of the most curious of these tombstone records is to be found in a graveyard in Donegal, which reads thus:—
"Here are deposited, with a design of mingling them with the parent earth from which the mortal part came, a mother who loved her son to the destruction of his death. She clasped him to her bosom with all the joy of a parent, the pulse of whose heart beat with maternal affection; and in the very moment, whilst the gladness of joy danced in the pupils of the boy's eyes, and the mother's bosom swelled with transport, Death's arrow, in a flash of lightning, pierced them both in a vital part, and totally dissolving the entrails of the son,

without injuring his skin, and burning to a cinder the liver of the mother, sent them out of the world at one and the same moment of time."

Lightning was amongst the most terrible of the old naval dangers. Ships were often set on fire by it. On the 4th of August, 1810, the *Audacious*, while at anchor off Flushing, had its masts set on fire by lightning, and was obliged to leave her station and return to Spithead. Some years previously, the *Lowestoffe* was set on fire in the same way in the Mediterranean, when two men were killed and several injured. On the 24th of May, 1825, the *Bellette*, at sea in the West Indies, was struck by lightning, having her main-top-gallant mast and topmast splintered. Five men were burnt, while thirty-six were struck down when hauling in the head-brace. The *Cambrian* was visited in the same way, on the 22nd of February, 1799, in the English Channel, when two men were killed and several hurt, twenty men being struck down on one side of the deck. While the *Thunderer* was cruising in latitude 18° N., longitude 79° W., on the 8th of September in the same year, she was dreadfully injured by lightning, and the whole of the watch in the maintop were paralyzed, it being necessary to lower them by ropes. Four men were killed, and twenty-four knocked down by lightning on board the *Captain* on the 27th of August, 1809; the *Repulse* was struck on the 13th of April, 1810, off Catalonia, when eight men were killed and nine injured; seven men were killed in a similar way on the 12th of August, 1808, on board the *Sultan*; and in 1794 the *Senata*, a Neapolitan ship, was struck, eight men being killed. Hundreds of other instances might be cited, but we have said sufficient to show that under the old order of things the lightning was a destructive agency that the mariner justly feared.

About the middle of the last century Franklin made his first experiments with the electric current, but notwithstanding all the honour heaped upon him for his discovery of the lightning conductor, the invention did not spread very rapidly in the land of its birth. Ministers of religion of all denominations, who looked upon Franklin as a freethinker, denounced his lightning-conductor, on the ground that as lightning was one of the means used by Heaven for punishing the sins of man, it was impious to attempt to stave off its natural effects. A Boston clergyman, who appears to have possessed some little knowledge of science, declared that the accumulation of electricity in the earth, brought about by lightning-conductors, was the direct cause of a heavy shock of earthquake, which was felt in Massachusetts in the summer of 1755. Even to scientific men the theory that those high rods had been the cause of the earthquake seemed plausible; but, in spite of all opposition, Franklin's invention worked its way into acceptance, slowly but surely, through the British colonies of North America. Franklin himself, and his friend Kinnersley, became the apostles of the new scientific doctrine, and travelled from one part of the country to another, advocating its adoption, and examining the effects of lightning upon buildings which had been injured by it. They gave directions as to how lightning-rods might be attached to any house by an ordinary blacksmith or carpenter, with the result that a number of defective conductors were erected that did more harm than good.

Franklin's great triumph was the erection of an improved lightning-conductor on the mansion of his friend Mr. West, a wealthy merchant of Philadelphia. Not long after it had been completed, an unusually severe thunderstorm broke over the Quaker city, one of the flashes of lightning striking the conductor on Mr. West's house, the electricity passing down into the earth without doing any more serious damage than melting the point of the conductor, which was made of brass. The flash was seen by a crowd of beholders to strike the point of the conductor, and to re-appear once more at the junction of the rod with the earth. From this latter phenomenon Franklin at once suspected that the portion of the earth in which the base of the rod was inserted was very dry, and thus arrived at the conclusion that all lightning rods should be buried so deep as to reach the moist earth. Experience has abundantly proved that Franklin's inference was correct. In addition, the melting of the thin brass top of the rod taught him that lightning-conductors must be of a certain thickness.

Although the resistance to the introduction of lightning-conductors was strong in America, it was nothing to the storm of opposition which Franklin's great invention encountered in Europe—especially in France. Much of this opposition, however, was purely personal. The first conductor set up in England was at Payne's Hill, by Dr. Watson. Little by little the prejudice against the invention vanished, and in course of years it was employed in every city of Europe.

Since those days lightning-conductors have been very greatly improved. Franklin's were originally made of iron, for the sake of cheapness; but, as time went on, and the science of electricity progressed, the researches of Davy, Antoine Becquerel, Pouillet, and others, proved that different metals possessed different powers of conveying electricity. Davy's experiments placed silver at the head of the list, copper almost close to it, and iron very far down indeed. Later investigations have confirmed Davy's figures within one or two per cent., and it is now generally agreed that a copper rod half an inch thick is just as serviceable as an iron rod $3\frac{1}{4}$ inches thick, hence copper is now in universal use, being accepted as the best, lightest, and in the end the cheapest metallic material.

But it took years of scientific effort to bring about these improvements. From the first, the rigidity of iron rods militated greatly against their use in the case of buildings with complicated outlines. Iron chains were proposed, but owing to their want of continuity were found to be a bad form of conductor. In 1815 Professor Von Yelin, of Munich, recommended brass wire ropes, which were for a while extensively employed, but they were not found to answer, first, because brass is but a poor conductor; and secondly, because the ropes were not large enough.

The subject was warmly taken up in France by some of its leading men of science, after the prejudices which had been such a thorn in the side of Franklin had disappeared, the French Academy lending the encouragement of its high authority at the suggestion of the celebrated Gay-Lussac. In 1823, the Academy published the first part of the semi-official *Instruction sur les Paratonnerres*, which Gay-Lussac edited. A second part followed in 1855, and another in 1864, both from the pen of M. Pouillet, the eminent electrician. In putting forth a translation of this "Instruction," in 1881, Mr. Richard Anderson, F.C.S., who has studied this subject to more practical purpose than any other Englishman of our time, drew a few comparisons which could hardly be considered flattering to our national pride. "Shall it be said again and again that 'they manage things better in France?'" he asks. He then goes on to say, "As regards lightning-conductors there can be no manner of doubt that they manage things better on the other side of the Channel than with us"; adding, "the French Government are in the constant habit of consulting the most eminent scientific men, as represented in the Academie des Sciences on the subject of protecting public buildings against the destructive influences of lightning. There is scarcely an instance in which a British Government ever did such a thing. It is true the Houses of Parliament had lightning-conductors erected upon them, upon some scientific advice, and at great cost. But all who understand the subject practically agree in saying that it is very doubtful whether the magnificent pile of buildings in which our legislators assemble is really—that is, efficiently—protected. Certain it is that one-half of our cathedrals, and three-fourths of our churches, have not even nominal protection. For all that science has done the Queen might any day be killed in her apartments at Windsor Castle, the Prince of Wales in Marlborough House, and the Prime Minister in Downing Street. To see the difference between England and France in this respect one has but to cross the Channel between Dover and Calais. At Dover there are huge barracks of great length, on the top of high hills exposed to the full fury of storms sweeping across the Channel; and the few conductors to be found upon them at long intervals are certainly not numerous enough for efficient protection against lightning. The contrast in this respect in passing the 'coy silver streak' is of the most striking. At Calais the Hotel de Ville, the highest building in the Grande Place, literally bristles with lightning-conductors, and so do all the churches and other chief buildings in the town. The same all over France. Without slavishly imitating our scientific neighbours, we might yet bestow some of the care they do upon the protection of our property as well as our lives against the terrible effects of the electric force." It is some satisfaction to be able to supplement this impeachment by the statement that Mr. Anderson himself was, not long after this was written, selected to inspect and put in order the lightning-conductors at the Houses of Parliament, and that the application of his scientific knowledge generally has been of great use in removing or reducing the force of his original charge that "they manage these things better in France."

It is nevertheless undeniable that the British Government have been very slow to move in this important matter. Except as regards the applicability of lightning-conductors to ships, all has been left to private enterprise. Nor even have the scientific bodies of the country devoted any special attention to the question. The Royal Society showed a very lukewarm interest in Franklin's discovery when it was first brought under its notice; but at that time France was even less in love with the lightning-conductor than England. Sir William Snow Harris insisted that it was the duty of the Government to place lightning-conductors, or see that they were placed, upon all objects that were liable to be struck; and more recently Mr. Richard Anderson has urged upon the English Government the importance of providing for a periodical inspection and testing of all such instruments, and there is no doubt the adoption of such a system—which surely must be arrived at sooner or later—would be a great additional safeguard.

So little progress was made in the multiplying of these protective appliances in the early part of the century, that the public authorities in some instances came to the conclusion that lightning-conductors were an additional danger rather than a protection. Mr. F.

McTaggart, a civil engineer in the service of the British Government, sent on professional duties to Canada in 1826, openly recommended the pulling down of all lightning-conductors, for "science," wrote Mr. McTaggart, "has every cause to dread the thunder rods of Franklin." In 1838, the Governor-General and Council of the East India Company ordered the removal of all the rods from their public buildings, including the arsenals and powder magazines throughout India, but the order was recalled not long afterwards by the authorities in Leadenhall Street, though not before a large magazine and a corning-house had been destroyed. Later on, Sir William Snow Harris, at the request of the Secretary for War, wrote a paper on the best means of protection for powder magazines and other stores of war material, and this paper is still issued from the War Office as one of the Army Circulars.

The recommendations of the French Academy, in the first report to architects and others engaged in the erection of lightning-conductors, was to see that the pieces of metal of which they were composed were thoroughly connected in all their parts, and that the earth end of the rod was buried at a sufficient depth to be surrounded by damp soil, the necessity for which had long before been demonstrated by Franklin. In the later report, of 1854, for which M. Pouillet was responsible, it was ordered that the iron rod should be made of greater capacity, that the joints should be as few as possible, and that they should be soldered together with tin, so as to secure perfect metallic continuity.

The copper rope, introduced by Mr. R. S. Newall, F.R.S., gave a more perfect continuity than had previously been obtained, and was more easily applied, being extremely serviceable for housework, and a great improvement on the old conductor with its joints and coupling pieces. For factory chimneys the rope was until lately usually constructed of forty-nine small wires, but a seven-wire copper rope has found great favour since its introduction by Mr. S. Sanderson in 1855, as being less liable to destruction from atmospheric influences. New inventions in connection with lightning-conductors are frequently brought out, but ninety-nine per cent. of them are of no practical value. According to Mr. Anderson, the only real improvement since the wire rope has been Sanderson's "Solid Copper Tape Lightning-Conductor, in continuous lengths, without joints, and of high conductivity copper." In 1876, Clerk Maxwell suggested to the British Association the idea (based on Faraday's experiments) of protecting a building from the effects of lightning by surrounding it with a sort of cage of rods, or stout wire. Here an "earth" would not be absolutely required. The suggestion had been made in a report to the Board of Northern Lights. It is possible, though not certain, that this form of defence might be useful against "globe-lightning," against which ordinary lightning-rods would be of little use.

The subject of applying lightning-conductors to ships forms the most interesting story in connection with this branch of scientific invention. As early as 1784, M. Le Roy, a Frenchman, had directed his attention towards the protecting of ships against lightning, and a detailed account of his plans was published in "L'Histoire d'Académie des Sciences" for 1790. His suggestion was to lead a permanent chain of copper rings along the maintopmast back stay. This chain "communicated with a point above, and with the water below, and appears to have been the first conductor

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ever applied to a French ship." The rings, however, were broken in a storm, which caused him to make some alteration, and to divide the chain into several parts, forming a line of communication along the masts, that, although connected, it should not suffer so much in rough weather, but should be better able to resist the effects. This method of defying the lightning was adopted by many French vessels, but did not get into regular use. In our own country, Dr. W. Watson, the enthusiastic supporter of Franklin's discovery, had urged Lord Anson, then First Lord of the Admiralty, to introduce lightning-conductors on all men-of-war, and he was asked to send in a design for a ship's conductor. Unfortunately, Dr. Watson's knowledge of ships and navigation was not equal to his knowledge of science, so he produced a rod that would have been effective enough on land, but which when subjected to the varying motions of a vessel at sea did not work very well. Dr. Watson's ship conductor was composed of strips of copper rod, one-fourth of an inch in diameter, hooked together every few feet by links, and the whole attached to a hempen line, hanging from a metal spike at the top of the mast and falling down into the sea. It was found that in a storm, when its service was required, it could not be kept in its place, so the sailors treated it with contempt, and disposed of the difficulty by throwing the copper-hempen chain away into some far-away corner of the ship where it could trouble them no longer. Still the reports of terrible fatalities from lightning at sea continued to increase year by year, and the attention of the authorities could not be diverted from the importance of making some special provision for the avoidance or lessening of these calamities.

But necessity brought forth the inventor who was to set this matter right. There was a young surgeon at Plymouth—William Snow Harris—whose mind had been directed towards the subject as he sat in his cottage overlooking the sea, and talked with his seafaring friends of the dangers and disasters they had encountered through the lightning striking their ships. He was wanting something to occupy his mind, for his practice was small enough to leave him an ample margin of spare time. He had a sympathetic nature, moreover, and the stories of vessels disabled and lives sacrificed by lightning at sea awoke the desire to do something for the lessening of these perils. With these promptings he entered upon his remarkable crusade against lightning. The battle was a long one, and a hard one, for the forces arrayed against him were officialism and prejudice, but he won the good fight in the end, and made for himself an enduring name amongst the scientific benefactors of the nineteenth century.

At the outset, Snow Harris made a strong case out for action by putting on record a heartrending list of ships that had been damaged by lightning in the forty years extending from 1793 to 1832, each instance being based upon official documents. He showed that in 150 cases, the majority of them occurring between 1799 and 1815, about a hundred mainmasts of line-of-battle ships and frigates, together with an immense quantity of stores, had been destroyed by lightning. One ship in eight, he set forth, had been set on fire in some part of the rigging or sails, and over 200 seamen had been killed or disabled by these visitations. Beyond this, it was contended that many ships reported "missing" had been sent to the bottom through the efforts of lightning-shocks. Nor were proofs in support of this theory wanting; the case of the *Peacock* was referred to, it being clearly shown by the evidence of the log of the *Lacædemonian*, that in the summer of 1814, while these two ships were alongside each other off the coast of Georgia, the *Peacock* suddenly disappeared in a storm of lightning, leaving not a trace behind. The *Loup Cervier* man-of-war was another ship of which there was proof that it went to the bottom in a thunderstorm off Charlestown in America. Then there was the story of the fate of the *Resistance* to swell the list. This famous ship, of 44 guns, had been struck by lightning in the Straits of Malacca, when the powder magazine exploded, and the vessel went to the bottom, only three of the crew being saved, but for whom, it was remarked, nothing would have been known of the fate of the ship, which would have been simply reported as "missing" in the Admiralty Lists.

The recital of these tales of disasters served to excite the public mind greatly, and protective measures were loudly called for. Still the authorities did not move, although all that was required was the adoption of an invention already made public. Snow Harris was not disposed to let the matter rest, however, simply because of the apathy of the official mind. He next brought the argument of cost to bear, and John Bull being generally impressionable on the economical side, he succeeded better on this tack than the other. Writing in 1847, Snow Harris laid it down that in about 120 cases only, the amount of money sunk on account of masts and other material ruined or destroyed, could not be set down, on a moderate computation, at less than £100,000. It was further shown that between the years 1810 and 1815, no less than thirty-five sail of the line, thirteen frigates, and ten sloops had been either disabled or greatly damaged by lightning; and that, taking into account every instance in which ships of the Royal Navy had suffered from lightning since 1793, and every expense contingent on the repairs and refit of the ships, the country lost from £7,000 to £10,000 a year in consequence of damage done to its Navy by lightning.

When Snow Harris began his agitation, about the year 1820, the ships of the Royal Navy were virtually without lightning-conductors. The time was ripe for action. In November, 1821, he addressed his memorable letter to Vice-Admiral Sir Thomas Bryan Martin, K.C.B., Comptroller of the Navy, "On the Effects of Lightning on Floating Bodies; with an Account of a new application of Permanent Conductors of Electricity to the Masts of Ships." After recounting the long list of disasters to ships from lightning, and referring to the claims of humanity, inasmuch as "many men had been deprived of sight or otherwise severely injured; many struck dead whilst employed in furling sails, and other naval duties, for want of a protecting point to which the electric matter would of necessity be determined;" he proceeded to set forth, in what was a most elaborate dissertation on the subject, his proposals for relief. "By observing," he wrote, "the probable sources and action of atmospheric electricity, we may conclude, without much liability to become involved in a speculative hypothesis, that a floating body is endangered by strokes of lightning under the following circumstances:—(1) An accumulation may take place in the atmosphere and discharge itself through the ship into the sea; in this case the highest or nearest points will be the first struck, and the injury sustained will be in the circuit which the electric matter has traversed. (2) The atmosphere may become in an oppositely electrified state from the former; thereby inducing a discharge from the surface of the earth, in which case the lowest points will be the first struck, and the lightning will ascend along the masts, producing similar mischief in its course."

He further explained that "floating bodies are, of all other artificial elevations on the earth's surface, the most exposed to such injuries; for, unlike buildings, which are in a variety of instances protected by the vicinity of high hills, trees, and the like, whose irregular forms frequently dissipate electrical accumulations, they are situate on what may be considered a vast plane, they themselves affording the only pointed projections; these extending sometimes nearly 200 feet above its level into the atmosphere, invite, as it were, the action of an electrical discharge, without having the means of palliating its fury." To counteract these dangers, he proceeded to urge, we had "only to construct for ships an uninterrupted metallic communication between the masthead and the water, and we provide the most effectual means of security against the extensive injuries from lightning which so frequently occur at sea." His proposal was, therefore, "to apply such a conductor as may be continuous and direct from the vane spindle at the masthead to the sea; as may be permanently fixed throughout its whole extent; yet admit of the motion of one portion of the mast upon another; shall in no way interfere with the standing or the running rigging; and in case of removal of any part of the mast either by accident or design, the continuity of the remaining part shall still be perfect, determine the course of the discharge and transmit it securely into the sea."

This letter, which was submitted to the public in pamphlet form, after having done duty at the Admiralty, did not produce any immediate effect, powerful and indisputable as were its conclusions. It was not until 1839, by which time the agitation had become too strong to be any longer disregarded, that a Naval Commission was appointed "to investigate the best method of applying lightning-conductors to Her Majesty's ships." A voluminous report followed, after a considerable interval, the Commission recommending, though in no very enthusiastic or positive tone, the trial of Snow Harris's system. The system consisted in the use of a double set of copper plates overlapping each other, and let into the mast of a ship in such a manner that the end of one touched the middle of the other, insuring perfect metallic continuity. Most of the vessels of the Navy were supplied with these conductors after the recommendation of the Naval Commission.

The Plymouth doctor might not have gained his point so soon but for the fact of having "friends at Court." He found a powerful patron in Sir George Cockburn, one of the Lords of the Admiralty, who was greatly interested in scientific progress. He had himself witnessed the serious effect of lightning upon ships under his own command. The *Minerva*, of which he was captain at the blockade of Leghorn, in 1796, had been struck by the electric current; and the same misfortune had happened to two ships of the flotilla under his command at the reducing of the French island of Martinique in 1809. At the period of Snow Harris's agitation, Sir George, retired from the Navy, sat in Parliament for Portsmouth, and was one of the Lords Commissioners of the Admiralty. He was also a Fellow of the Royal Society, and Snow Harris being a member of that body, the two were drawn into a friendship which proved of the greatest advantage to the young surgeon. The enthusiasm of the latter attracted Sir George, who made a personal study of the subject of lightning-conductors, and at every subsequent stage of the movement was Snow Harris's best advocate. Even previous to the issuing of the report of the Naval Commission, Harris was allowed to make experiments with his system on board several men-of-war. When the plan was ultimately adopted, the ardent electrician reaped his reward, receiving at various times considerable grants from Government, and having the honour of knighthood conferred upon him in 1847. While Sir William Snow Harris's system lasted it was thoroughly effective, and more than answered the fullest expectation. Not a single ship of all those to which his lightning-conductors were applied was damaged by lightning, although many were struck. When, however, the "wooden walls" disappeared, and iron became the material of construction for the ships of our Navy, the lightning-conductor was no longer a necessity, for an iron-built vessel, metal rigged, forms a conductor in itself, affording more absolute protection than any metallic rod or rope could do, however high its conductivity.

But, although there is no longer the need there was to fight the lightning at sea, we must still continue our protective efforts against its devastating influence on land. There is no need for scientific endeavour to be relinquished or slackened because the sphere of operation is not so large as formerly. What is most urgently required, however, is an official system of inspection which shall be equal to the enforcing of the best appliances for all important buildings throughout the country. Until this has been accomplished we shall not have satisfied the reasonable demands of science and the due regard for public safety.

CHAPTER VIII.

PROTECTION FROM FIRE.

The ancient and modern history of fire protection is remarkable and interesting—remarkable from the fact that notwithstanding that trained firemen existed in Roman cities two thousand years ago, yet to the present day it has not been thought worth while for our own Government to make the complement of them in the greatest city of the world numerically efficient, and interesting for the comparisons afforded between the implements in use in primitive times, and those which find favour now.

From the ancient Hindu law, the laws of the Romans and the Greeks, from the Imperial decrees of the Emperor Augustus, who wore the purple at the time of the birth of our Saviour, we gather that the engineers of those days knew how to make fire pumps with air vessels and valves, whilst for many centuries the chief of the fire brigades in many European countries were priests of the church—their appliances a bell, a reliquary, and a stoup containing blessed water. The dwellings—indeed all buildings in Great Britain down to the time of Alfred the Great—were built of timber. Alfred began to build his palace of brick and stone; but in the year 1136 the greater part of the city of London was still built of wood, and the houses were covered with straw, stubble and the like. Hence it happened that when a single house caught fire, the entire city was endangered. An occurrence of this sort is on record as having taken place in the first year of the reign of King Stephen, and to avoid such a peril in future, the citizens inaugurated stone and tiled houses. Regulations upon the subject seem first to have been framed in the reign of Richard I. (1189) by the Lord Mayor of London and the wardmotes of the city, who adopted the following rules :—" That all persons who dwell in great houses within the ward have a ladder or two ready and prepared to succour their neighbours in case misadventure should occur from fire. That all persons who occupy such houses have in summer time, and especially between the Feast of Pentecost and the Feast of St. Bartholomew (Aug. 24), before their doors a barrel full of water for quenching such fire, if it be not a house which has a fountain of its own. That ten respectable men of the ward, with the aldermen, provide a strong crook of iron with a wooden handle, together with two chains, and two strong cords, and that the handle have a good horn and loudly sounding. Of persons wandering by night, it is forbidden that any persons shall be so daring as to be found wandering about the streets of the city after the curfew rang out at St. Martin's-le-Grand, and St. Lawrence, upon pain of being arrested."

The regulations of succeeding years contained similar ordinances; the night-watch in every town and city was originated, and throughout this country and the continent measures more frequent and efficient were ordained to preserve life and property from fire.

It had long been the custom in continental cities to place a watchman on the top of a large building or tower to look out for fires, notice of which was conveyed by blowing a horn, firing a gun, or ringing a bell. In

Germany, particularly, was this practice carried out, two watchmen being posted on each steeple to look out for fires; and although the necessity for such "look-outs" has almost entirely disappeared, yet the Observatory of the Metropolitan Fire Brigade at Southwark to-day is not an unimportant adjunct to the efficiency of Captain Shaw's administration.

Paris may be credited with the first penal regulations, having in 1371 enacted that each householder, under a penalty of ten sous, must place a hogshead of water at his door. The Ordinance of Worcester, too, was very stringent on the subject of replacing the thatched with tiled roofs, and the proclamations regarding the construction of buildings were very frequent up to the commencement of the seventeenth century. At this period more practical efforts were made by those in authority at home and abroad to increase the precautions and supply better means of dealing with fire. In the middle of the century, if we judge from Lord Macaulay's History of England, the country narrowly escaped having a *steam* fire-engine, which, however, she was not destined to obtain until getting on to nearly two hundred years later. Says the historian: "The Marquis of Worcester had recently observed the expansive power of moisture rarefied by heat. After many experiments he had succeeded in constructing a rude steam engine, which he called a fire waterwork, and which he pronounced to be an admirable and most forcible instrument of propulsion. But the Marquis was suspected to be a madman, and known to be a Papist. His invention, therefore, found no favourable reception."

With the history and description of fire-engines, escapes, and other appliances we shall deal later in the chapter, preferring at present only to trace the development of earlier regulations into legislative enactment, the data of which were to a very considerable extent compiled by the late Mr. Cornelius Walford, and brought together in his exhaustive Insurance Encyclopædia.

The Great Fire of London (referred to in another chapter) caused to be enacted three important measures: the first, "An Act for rebuilding the City of London"; secondly, a Proclamation of the King, commanding "all persons having lodgings within His Majesty's palace at Whitehall to have so many leather 'Boquetts' as there were chimneys within their respective lodgings, and that the same should be kept in readiness upon all occasions"; and thirdly, "An Act for preventing and suppressing of Fires within the City of London and Liberties thereof." Nevertheless, it may fairly be asserted that for nearly a century there was no practical legislative effort in this direction. To private enterprise was due, first, the suggestion, and subsequently the establishment, of anything like a properly organized scheme of coping with fire. William Ryley and Edward Mabb petitioned Charles I., but without success, for leave to establish a system of fire insurance involving the duty of maintaining a watch, and a supply of apparatus, with reserves of water in convenient places for sudden use. Fifty years later, in 1681, the Corporation of London made an abortive attempt to introduce protective measures; but the comical scene, when occasion required, of the magnificent beadle and his troop of young leather breeches dragging the parish engine to a fire and professing to pump upon the flames continued to be a grotesque exhibition until two fire offices established "a great many servants in livery, with badges, for the purposes of fire protection," with the necessary appliances. The system was a self-interested one, of course, in the first instance, seeing that the companies were not bound to take care of any property in which they were not directly concerned. But the curious part of the matter was that the companies not long afterwards ceased to feel that kind of interest, and actually kept up the engines and brigade men at a loss, until the public authorities took the duty up. The fire insurance companies began to regard fire-engines as an essential part of their establishments, for the less damage was inflicted on the property for which they had granted policies the less they would have to pay to the persons insured. They bought, each company for itself, as many fire-engines as they pleased, and paid for as many men as they chose to manage them. When a fire occurred out rushed these engines, with no paucity of heroic daring on the part of the men. But then two evils arose. Each corps cared only for such houses as were insured in one particular office, and deemed it no matter of duty to save adjacent property. The other evil was that the men quarrelled with each other as to precedent claims for reward, and sometimes fought while the flames were raging. To lessen, if not remove, these evils was the purpose of a very useful arrangement made about sixty-two or sixty-three years ago. The managing director of the Sun Fire Office proposed that, without interfering with the independent action of the companies in other ways, they should place all their fire-engines in one common stock, to be managed by one superintendent, under a code of laws applicable to all the firemen, the system to be administered with due impartiality to all the partners, and paid for out of a common purse, to which all should contribute. It was a sagacious suggestion, proper to come from the largest of the companies; but as some minds move more slowly than others, so do some companies fall in more readily than others with a new and bold proposal. At first the Sun, the Union, and the Royal Exchange were the only companies which entered cordially into the scheme. The Atlas and the Phœnix afterwards joined, and this limited partnership lasted until 1833.

Fire protection meanwhile was being regarded elsewhere as an important subject upon which to legislate, and enforce regulations. The Scottish Parliament had passed an enactment so far back as 1698 prohibiting the erection of buildings in the city of Edinburgh more than five stories high, and appointing "Fyre Masters," &c., with special duties. In succeeding years Edinburgh adopted numerous precautions, and as a city was destined to supply London with its head of the Fire-Engine Establishment—the gallant James Braidwood, who fell bravely at his post at the great fire in Tooley Street, London, twenty-six years ago. Glasgow, Liverpool, Exeter, and numerous other cities were aroused to enthusiasm, with the result that they achieved efficiency in their services which they now continue to develop.

The first general measure for providing the means of fire protection was passed by the English Parliament in 1830, when it was enacted (2 George IV. c. 27), amongst other things, "that it shall be lawful for the said inspectors, and they are hereby required from time to time, to provide and keep up fire-engines with pipes, and other utensils proper for the same, for the use of the parish adopting the provisions of this Act, and to provide a proper place or places for the keeping of the same, and to place such engines under the care of some proper person or persons," &c.

In 1833 the London Fire Brigade Establishment was founded, and its history has been written by Captain Shaw, than whom no expert in one special subject has given to the world more valuable service in technical literature. The arrangement of the establishment was peculiar, and may be very briefly described. Any insurance company might belong to it on paying a fair quota of the expenses, and, generally speaking, the companies all joined. Each board of directors sent one or more delegates to represent it, and the delegates formed the committee for managing the system. All the engines and apparatus, floating engines, and engine-houses belonged to the committee, and out of the funds provided by the several companies the committee paid the salaries of the superintendent, inspectors and firemen. The Metropolis was divided into districts, convenient as to size and relative position, and each district had a station where engines were kept, with firemen always ready to dash out when their services were needed.

The destruction of the Houses of Parliament by fire on the 16th of October, 1834, demonstrated that even the London Fire-Engine Establishment was insufficient to cope with catastrophes of such magnitude, and a communication, dated the 9th of December, 1834, signed by the representatives of the associated offices, was addressed to the Government, through the Duke of Wellington, on the subject. It was acknowledged in February of the following year in a reply containing the following passage :—"I am not disposed to deny that there are cases of fire in which arrangements which you recommend might be productive of beneficial consequences ; but nevertheless it appears to me that in the majority of instances the interference of Government would be productive of little benefit, while it might and probably would relax those private and parochial exertions which have hitherto been made with so much effect, and so much satisfaction to the public." The subject thus dropped out of sight for the moment; nevertheless there were many Acts passed in succeeding years, having a direct bearing upon regulations in building or otherwise, for the protection of London and the provinces against fire.

In 1862 a Select Parliamentary Committee was appointed "To inquire into the existing state of Legislation, and of any existing Arrangements for the Protection of Life and Property against Fires in the Metropolis."

The recommendations of the Committee were, (1) That a fire brigade be formed, under the superintendence of the Commissioners of Police, on a scheme to be approved by the Secretary of State for the Home Department, to form part of the general establishment of the Metropolitan Police, and that the Acts requiring parishes to maintain engines be repealed; (2) That an account of the expenditure of the new Police Fire Brigade be annually laid before Parliament, together with the general police account, in such manner that the special cost of the Brigade may be ascertained; (3) That the area of the new Fire Brigade arrangements be confined within the limits of the jurisdiction of the Metropolitan Board of Works, with the option to other parishes to be included if within the area of the Metropolitan Police.

This Committee's report concluded with the following statement of opinion:—"No security can be given by legislation on this important question which would supersede the necessity for individual care by the occupiers of houses against the risk of fire; no precaution can prevent the occurrence of fires, nor can any public measures be enacted which could or should prevent individuals from suffering losses from those acts of carelessness from which fires generally arise; public measures can only be of real service in arresting the progress of fires when they occur, and in preventing the enormous losses which arise from allowing a fire to attain to any considerable dimensions."

The real object of the promoters of this inquiry was to shift the burden of the protection of the Metropolis from the shoulders of the fire offices to those of the Metropolitan Board of Works, and although they were not immediately successful, yet the object was afterwards attained in 1865, by the passing of "An Act for the Establishment of a Fire Brigade within the Metropolis." The Act came into operation on the 1st of January, 1866.

Another Select Parliamentary Committee was appointed in 1867, to "inquire into the existing Legislative Provisions for the Protection of Life and Property against Fires in the United Kingdom, and as to the best Means to be adopted for ascertaining the Causes and preventing the frequency of Fires."

The Committee found there had been numerous Acts passed affecting the whole kingdom, while there were also local Acts in many instances making provision for the preventing and extinguishing of fires. They recommended a General Building Act for all towns and places in the United Kingdom, and, *inter alia*, an inquiry into the causes of every fire.

The fire which destroyed the city of Chicago in 1871 led to a good deal of discussion and investigation regarding the condition of London. The *Times* arrived at the conclusion that there was no great city in Europe exposed to such risks as London; but concluded a leader thus:—"Happily the Metropolitan Board of Works seems disposed to maintain an efficient fire brigade. The difficulty of concentrating the efforts of the entire staff of that force at a given spot in time to stop the spread of a fire which has once seized hold of a street of City warehouses is one which has not been lost sight of. The Board and Captain Shaw have been devoting much attention to the floating engines, and also to the thorough training of the men. Probably no such climbers can be found in any other city as the firemen of London. For some years past no man has been taken into the force who had not previously been a sailor, and it has been found that with a shorter drill than any other class sailors become the best firemen. The powerful and continuous stream of water poured upon a fire from one of the floating engines makes them extremely powerful auxiliaries in extinguishing a vast fire. We have four, and even the United States can boast of nothing like them."

In 1873 there was introduced into Parliament "A Bill to make provision for Investigation into the Causes and Circumstances of Fires"; but it did not go forward, though the subject of fire protection was again brought before Parliament in 1876, and a Select Committee was appointed "to inquire into the Efficiency, Emoluments, and Finance of the Metropolitan Fire Brigade; also to inquire into the most efficient Means of providing further Security against Loss of Life and Property by Fire in the Metropolis." Mr. Ritchie, M.P., in bringing the matter under the notice of the House of Commons, gave some information on the subject. The force at that time (1876) numbered only 395 men of all ranks, including the chief officers and superintendent. The several watches in London employed 94 men by day and 181 by night, including those who were on fire-escape duty, making a total of 275 for the 24 hours. If they deducted the men with the fire-escapes, which numbered 106, it left the Metropolis, with an area of 120 square miles, to the protection of 164 men. He would not compare the old London Fire Brigade with the present one, for its appliances had been much improved; but the proportion of men to the requirements had diminished. The fires had increased from 1,338 to 1,559, or just 17 per cent., the numbers of the houses and the population had increased 17 per cent., and they had the number of firemen decreased by 20 per cent. The Select Committee sat in 1876, and took very voluminous evidence, and on the 20th of July they reported the evidence with appendix to the House, recommending the re-appointment of the Committee in the next session. The conclusions at which they arrived, and which were dated the 17th of July, 1877, were as follows:—(1.) That the statutory arrangements for the extinction of fires in the Metropolis, whereby the Fire Brigade is administered by the Metropolitan Board of Works, two separate police forces exist side by side, and the water supply is sectionally furnished by eight independent companies, are not such as to furnish adequate protection to life and property; and contrast unfavourably with provincial systems, where the fire brigade, water supply, and police are under a single authority, and that consolidation of management as far as is practicable is urgently required. (2.) That the Fire Brigade should be transferred from the Metropolitan Board to the Commissioner of Police for the Metropolis, so, however, as to constitute a distinct branch, to be placed under the immediate command of a separate Assistant Commissioner, and to be authorized to act within the City of London as well as in the Metropolis. (3.) That the members of the Fire Brigade should be entitled to superannuation on the same terms as those applying to other constables of the Metropolitan Police Force, liberal provision being made for those now serving in the Brigade. (4.) That the police stations and the fixed points should be used as Fire Brigade stations, or as places where small engines or other appliances should be deposited, and that all police constables, both of the Metropolis and the City, should be auxiliary to the Fire Brigade; but that, as now, each force should be empowered to act only within its own jurisdiction, except on a special requisition. (5.) That in lieu of the limit of one halfpenny on the consolidated rate, there should be substituted a limit of a penny rate on the Metropolitan Police District, and that the amount of the Government contribution be reconsidered. (6.) That the contribution from the insurance companies be continued at the present rate, and that a charge should be levied on owners of uninsured property saved from fire. (7.) That hydrants should without delay be affixed to main and service pipes wherever there is a constant supply. (8.) That the water systems now belonging to the various companies should be consolidated in the hands of a public authority, which in dealing with the questions of constant supply, pressure and pipage, should be bound to have regard not only to the convenience of consumers, but also to the requirements of the extinction of fires. (9.) That no new theatre or large music-hall in the Metropolis should be finally licensed until certified that, in respect of position and structure, it satisfies all due requirements for the protection against danger from fire, and that the Metropolitan Board should be the certifying authority. (10.) That with respect to existing theatres and halls the Metropolitan Board should have power to call on the proprietors to remedy such structural defects as appear to the Board to be the cause of special danger, and to admit of being remedied by a moderate expenditure, option being allowed to the proprietor to refer the whole question to arbitration. (11.) That with a view to the prevention of danger from fire, the Lord Chamberlain and the justices should be authorized to make regulations as to the management of theatres and music-halls under their jurisdictions; that for the purpose of ascertaining whether such regulations are complied with provision should be made for the inspection of these buildings, and that any breach of the regulations should be punishable on summary prosecution. (12.) That effect should be given by the Legislature to these recommendations.

The recommendations of this Committee did not exactly suffer the fate of those of the Committee of 1867, although it was not until ten years after the Committee had reported that a measure was brought into the House of Commons. It has not yet been passed, although interest in it was increased upon the recurrence of a gigantic fire at Westbourne Grove, London, on the 6th of August, 1887, when property was destroyed of the estimated value of half a million sterling. On the Monday following questions were asked in the House of Commons, and again on Tuesday, the 9th of August. The First Lord of the Treasury was asked whether his attention had been directed to the large number of fires which had occurred in the Metropolis on one day previously, whether he was aware that the pressure on the resources of the Fire Brigade was almost unparalleled in its severity, and whether, having regard to the safety of life and property involved, he would afford facilities for discussing the Bill? In the congested condition of public business, however, the Bill had to be set aside, but there is every likelihood that most of the recommendations of the Committee will ultimately be adopted.

Auxiliaries to the larger and older organizations are the Salvage Corps and the Volunteer Brigades, upon which even now a large proportion of provincial towns and agricultural districts have to rely. A succinct account of the former corps was written a few years ago by a Yorkshire volunteer fireman, Mr. Henry J. Barber, and the story of the Volunteer Brigades has also its special interest. Ten years ago there was a great awakening among volunteer firemen, and the publicity afforded to the proceedings of the brigades stimulated the majority of them to acquire improved appliances and more dexterity in handling them. The years 1880 and 1881 were remarkable for Fire Brigade competitions, and the Associations were at their best. The number of these gatherings have increased yearly, and a permanently good effect has been produced by the revival. Many of the small towns are now (1887), having regard to their size, and the number of their fires, as efficiently protected as London, Liverpool, and Manchester.

Turning now to the history and progress of fire appliances, we find that from time immemorial China has been acquainted with manual fire-engines in some form or other, and it is fair to assume that she has continued progressive, inasmuch as a year or two ago she achieved the position of being the only nation that has introduced the element of personal responsibility in cases of fires.

Ctesibius, an engineer in the city of Alexandria, who lived 120 years before the commencement of the Christian era, is, however, credited with the invention of the first pump, described by Hero of Alexandria as having metal cylinders, metallic pistons, spindle valves, with guards to prevent their opening too far; a gooseneck formed by a kind of swivel joint—something like a union or coupling screw, the application of an air vessel; two pumps forcing the water through one pipe, and one lever to work both pumps. All these are features more or less essential to fire-engines in the present day, though some of them have been claimed as later inventions; but other mechanical appliances are requisite to a fire-engine as now understood. Pliny the elder speaks of water being forced up by pumps and such-like, "going with the strength of the wind enclosed." Pliny the younger, probably about A.D. 100, applied to the Emperor Trajan for authority to establish a fire brigade, and spoke of a "Sipho," by which water could be projected to a considerable height; and we have it on the authority of Ulpian, an eminent Roman citizen, that there were fire-engines in Rome in A.D. 228. So much, then, for ancient history. Coming down to the latter part of the sixteenth century, we find that hand-squirts first made their appearance in London; but the embryo modern fire-engine, which originated in Holland, was not known until 1672. "At this time," says a writer in *The Fireman*, "the Low Countries were at the zenith of their commercial prosperity, and five years before a Dutch fleet had appeared on the Medway, and Holland was able to contend with England upon equal terms for the empire of the East, and for the sovereignty of the seas. The fire department of the capital at this time was under the direction of two brothers named Van der Heide. These men were good mechanics, and had a turn for literature; and they were also in every sense of the word firemen, and their work in this capacity deserves lasting recognition. The invention with which their name is chiefly identified is that of flexible delivery and supply hose, which were brought out, together with engines capable of using it, in the year we have mentioned. Previously to this the Dutch fire-engines were constructed to take water from their own cisterns, and to discharge it through long copper swivelling tubes fixed to the outlets. Even these were a distinct advance upon our English appliances, which were only hand-squirts, throwing about a quart of water at a time. The Van der Heiden made both suction and delivery hose of leather, sewn at the seam, and joined the lengths together with brass couplings."

It would seem, however, that something more effective than hand-squirts was in use in England in those days; for, in the Inventions Exhibition of 1885, there was an old fire-engine on view, which was said to have been made in 1575, and was used as late as 1845 at Dunstable. It was not stated upon what authority the date of its manufacture was arrived at. The engine consisted of a long barrel-shaped body, fixed on a kind of lorry with low wheels, and the pump, a single action one, was worked by a lever at both ends. Each lever worked upon a fulcrum; the levers were raised and depressed simultaneously, and moved what was really the ram or plunger of a large squirt. There were no valves or air vessels.

Again, Mr. C. F. T. Young, whose book on Fire, Fire-Engines, &c. (1886), is the only exhaustive work on the entire subject which has been published, brought together quite a host of fugitive facts, which would lead to the belief that engines were at any rate in promiscuous use in England anterior to the date of the Van der Heiden.

Nevertheless, at the most serious conflagration reported at which engines of any capacity were used, three were brought into requisition, "presumed by the authorities to have come from Holland." The fire was on London Bridge, in 1633, and at a later date it is recorded that improved manual fire-engines were brought from Holland by William III. when he landed at Torbay, so that there is little room to doubt the credit accorded to the Dutch brothers for the invention.

In 1674 Sir Samuel Morland, the reputed inventor of the speaking-trumpet, manifested great interest in the subject of fire-engines, of which, indeed, he became a maker. He offered engines for sale, ranging in price from £23 to £48. The first engine with leathern pipes ever used in this country was brought into requisition at a fire at Southwark, in 1676, when 500 houses were destroyed, and the old St. Thomas's Hospital was saved by the new appliances.

Engines continued to be constructed of varying efficiency; air vessels were employed in their manufacture; and syphons, or attracting engines, for raising water to extinguish fires; but "it was in the first quarter of the eighteenth century," writes Mr. Young, "that the manual engine began to have the attention of observant and practical men given to its development and improvement, when the results were of a most beneficial and satisfactory character. By these improvements the engines were greatly increased in utility and efficiency, and the special advantages and conveniences to be gained by the invention and application of flexible hose were enabled to be fully brought out." It is impossible to treat such a subject with any degree of detail without referring to private enterprises, which, like the companies that established a regular protective organization, are solely self-interested, and possibly in open rivalry. Therefore we need make no apology for identifying with the commencement of the "development and improvement" spoken of by Mr. Young, primarily the firm of Messrs. Merryweather and Sons, of London and Greenwich. For nearly two hundred years this firm has been identified with the manufacture of fire protective and life-saving appliances, as also for a more limited period, but very largely indeed, have their rivals, Messrs. Shand and Mason, of London. Combined, these firms produce the chief fire-engines, escapes, &c., of the world, most of the more important engines and appliances being the inventions of one or other of the proprietors, whilst they have been concerned in the bringing forward of many of the contrivances invented by others.

In 1807 Mr. Hornblower brought out a small portable fire-engine, which was a very effective machine, and could be carried from one part of the house to another; in 1820 Mr. Michael Rough proposed to furnish every house with a wheeled machine capable of containing ten gallons, to be kept full of water until after sunset. But the great invention, eclipsing all the rest, was the steam fire-engine of Mr. John Braithwaite, of London, constructed in 1830. It is a curious matter of history that though its efficiency was at once demonstrated—the engine was first requisitioned at a fire at the Argyle Rooms, when the cold was so severe that the manuals became frozen and useless—yet it was several years later before it was brought into general use. In this matter France, Russia, Germany, and one or two English provincial towns forestalled London, in consequence mainly of the circumstance that Mr. Braidwood, the chief of the London Fire-Engine Establishment, believed that the supply of water in the Metropolitan mains was really insufficient for its requirements. In 1838 Messrs. Bramah and Robinson invented the "Swiss Portable Engine," which could be carried on the back of one man; and in 1850 the first steam fire floater was constructed by Mr. P. Clark, assistant-engineer of the West India Docks. Manual floaters had been used on the Thames by the insurance companies since the latter part of the eighteenth century.

The International Exhibition of 1851 provided a grand field day of steam fire-engines in Hyde Park, at which Marshals Shand and Mason, General Merryweather, and other steam magnates showed what they could do. One engine shot forth three hundred gallons of water a minute; and another sent up a jet to a prodigious height, showing how useful such a power would be for application upon a lofty building. In some of the steam engines such was the arrangement of the boiler and flues that the water could be raised from the freezing temperature to the boiling point in ten or twelve minutes. Then, as now, the attendant genii had not to wait for steam before they started; the boilers were filled with water, the fire lighted, they were galloped away, and upon arriving at the scene of conflagration the water boiled, and the steam was ready for using. All the engines, steam and hand, have their regular quota of apparatus stowed in and around them—scaling-ladders, canvas sheets, lengths of hose, lengths of rope, hose-pipes, rose-jets, hooks, saws, shovels, pole-axes, crowbars, wrenches, &c. Messrs. Shand and Mason were the first to apply steam power to the float of the London Fire Brigade, in 1852, and in consequence of its efficiency they built the original powerful self-propelling floating steam fire-engine which is still in daily use for riverside work on the Thames.

The smaller engines are legion, and a great impetus was given to the use of hand engines by a letter from the Earl of Essex to the *Times* in 1866, in which he attributed the salvation of Cassiobury, his seat in Kent, to the prompt use of one of them. In 1862 Mr. Wm. Roberts, of Millwall, constructed the first self-propelled steam fire-engine ever made in England or Europe, although one had been built in America in 1840-1 by Mr. Paul Rapsey Hodge, an English engineer. Mr. Roberts' engine travelled along the roads at the rate of eighteen miles an hour. At the International Exhibition in 1873 fire-engines, steam and manual, formed a very prominent feature; most of the countries in Europe, as well as the United States, were competitors. Since then steam fire-engine construction has been greatly improved, but chiefly in points of detail. In manual fire-engines, the chief advance has been in regard to the mechanical arrangements for getting the engine into action.

It may here be remarked that in 1887 the London service comprised 589 men, 45 steamers, 77 manuals, and 55 engine stations.

The fire escape, which now forms such a material adjunct to all brigades, has not such an ancient or voluminous history as the fire-engine. David Marie patented a fire escape in 1766, and there were several subsequent improvements, but the first escape of which we have any details was that of Mr. Davis, in 1809. It consisted of three ladders, to draw out like a telescope. In 1813 Mr. Young contrived a sort of rope ladder, with iron rounds of very flexible construction. The next invention was in 1816, by Mr. Braby, of which a pole was the chief characteristic, down which a chair or cradle would slide, governed by a rope. It was in 1819 that the foundation of the escape at present in use in London was invented. Mr. J. Gregory patented a fire-escape ladder consisting of sliding sections placed upon a movable carriage, and capable of being extended by the successive drawing out of the separate parts. Some thousands of inventions have followed this, but principally affecting mechanical detail, and for the last ten years hundreds of new designs have been protected at the Patent Office annually. The test of time has yet to be applied to all of them, which are mainly for domestic use, and consist chiefly in complications of ropes, pulleys, &c. Several varieties of the Fire Brigade carriage escapes are among the later inventions, and are those of the firms which have supplied the one in popular use, and upon which they are improvements based upon experience.

With the object of saving life from fire an association, under the title of the Fire Escape Society, was founded in 1828, and as a matter of fact, which seems somewhat incredible, it was a distinctive service so recently as 1867. Mr. John Hudson, of Cheapside, London, was the founder. He was struck with the inefficiency of the system of parish ladders, which prior to the earlier period were the only appliances of rescue, and he agitated for more ample means. In 1836 the Society was merged in the Royal Society for the Protection of Life from Fire, the special feature of which was the provision of fire escapes in London. The Association existed until 1867, at which date it had 85 fire-escape stations. The escapes had attended 695 fires and saved 78 lives. In August of that year the plant, &c., passed over to the Metropolitan Board of Works, under the provisions of the "Fire Brigade Act, 1865."

To attempt to deal with all the subsidiary inventions for the prevention of fire, protection from fire, or the simple and ready extinction of the dreaded visitant, would be a task of invidiousness, and in fact of too great magnitude for the compass of the present chapter. It is not now as it was in 1810. Then the inventor of a fire-proof cement was such a singular individual that he actually obtained from Parliament a legal monopoly for what he called "Tessera"—a cement for covering buildings and protecting them from fire. Now the heterogeneous mass of concoctions which are patented year by year are innumerable. The safest and surest method of preventing fire in all places is extreme vigilance, no relaxation of regulations, and in taking advantage of the ordinary precautions. In large establishments hydrants and mains arranged under the system which Captain Shaw devised for Christ's Hospital, and which that enthusiastic expert has supervised in numberless similar instances, is probably the most effective. Exceptional institutions require exceptional measures of precaution. As theatres are generally regarded as being established for the gratification of the Fire Fiend, a number of special protective appliances have been invented for them, including iron curtains, automatic sprinklers, and so forth; and, acting on the terrible lesson of the Exeter calamity of 1887, all authorities possessing control over theatres in this country have instituted more rigorous regulations than previously prevailed in respect of the facilities of egress from theatres. Mr. Henry Irving has been to some extent the mouthpiece of managerial solicitude in this matter, and has designed (on paper) what would seem to be an almost fireproof theatre. With respect to the recent invention of automatic sprinklers, it should be added that they are equally available for mills and warehouses. They are fixed in any or all parts of the premises, and will discharge regular streams of water when the temperature rises to a certain height, or the action may depend upon the turning of a valve. In the case of theatres the main idea in adopting the sprinklers would not be so much to protect the property, but to check instantly an outbreak when the house is full ; therefore the action should depend upon a fireman stationed at the valve for that purpose, because if a fire were to break out on the stage, and it was requisite to allow twenty or more seconds to elapse before the metal was fused, and the water let loose, there would be a sufficient time to engender a panic, which might prove as destructive as if there had been no automatic system in existence.

There have been many other novelties in fire-extinguishing machinery invented recently, notably hand grenades and other chemical contrivances, but inventions relating to extinctions almost entirely consist of improvements in old appliances.

CHAPTER IX.

HISTORIC FIRES AND WONDERFUL RESCUES.

Ever since, as the legend has it, Prometheus the Titan stole fire from the chariot of the Sun and brought it back to earth again, that destructive element has been the devastator of continents, and the terror of the human race. With all the resources of civilization, and in the face of all the inventive genius of the world, mechanical perfection in saving life from fire is yet far from being arrived at; and although, compared with the earliest times, the appliances now at our disposal are remarkably complete, yet year after year instances are chronicled where human sacrifices would have been more appalling, and the loss of treasure more gigantic, had it not been for the undaunted courage and personal heroism of men and women, as well as the sagacity of the canine and even the equine races.

Fires in Anglo-Saxon England were both frequent and destructive, which is not to be wondered at when we recall the picture of the country in those days. The clusters of wooden cabins which nestled in the valleys, with the great wooden hall, and the wooden church (sometimes covered with lead, as Glastonbury Abbey, rebuilt by St. Paulinus), were easy prey for the flames. Once well alight the whole was doomed, whether it was the fortified "burgh," the walled-in "ton," or the "ham," the simple unprotected dwelling of a collection of families. Any organized method of saving the villages from destruction was quite unknown. The simple peasants were by no means fatalists, who stood idly by and saw their homes consumed without making an effort to save them. There are few notices of fires in Saxon writings in which the efforts put forth by the people to stop their progress is not mentioned. The chief reliance, however, was placed upon the miracles wrought by the pious bishops and clergy.

Bede has many accounts of these interpositions of Providence. Here is one of them. The Bishop Germanus (A.D. 429), whilst staying at St. Albans, fell and broke his leg "by the contrivance of the devil." Whilst thus detained a "fire broke out in a cottage neighbouring to that in which he was, and having burned down the other houses, which were thatched with reed, was carried on by the wind to the dwelling in which he lay." Under these critical circumstances Germanus, with considerable obstinacy, refused to be moved. However, the Fire Fiend respected the good bishop, and though he ruthlessly destroyed whatever the multitude endeavoured to save, in order that the people might thereby be the more impressed, "the flame spared the house that gave entertainment to the holy man, raging about on every side of it, whilst the house in which he lay appeared untouched." An almost precisely similar miracle is recorded of Archbishop Mellitus, in Canterbury, A.D. 619–624.

It was not only the prelates and holy men who had the power of performing miracles of this kind; the power was extended to inanimate objects. At the spot where St. Oswald, King of Northumbria, was killed (probably situate at Oswestry, or at Winwick in Lancashire), many notable cures were effected by mere contact with the earth. Some of this earth, carefully tied up in a linen cloth by "another person of the British nation," worked wonders in a "certain village."

The "person" arrived there at night, and entered a house, at which he was hospitably received; "the neighbours were feasting at supper; he sat down with them at the entertainment, hanging the cloth in which he had brought the earth on a post against the wall. They sat long at supper and drank hard, with a great fire in the middle of the room. It happened that the sparks flew up and caught the top of the house, which, being made of wattle and thatch, was presently in a flame," whereupon, in this instance, the guests being the reverse of pot-valiant, incontinently fled, and left the house to its fate. The official report, if there had been one in those days, would have recorded a total loss, with the exception of the post on which the linen bundle containing the earth was hung. That remained entire and untouched, and made the reputation of St. Oswald's death-place more famous than ever.

The village and church of Landisfarne, off the coast of Northumberland, and a few miles below the mouth of the Tweed, were burnt by Pruda, King of the Mercians (A.D. 651), and here again was a wonderful post—the only thing which the fire left standing entire and untouched. It was then recollected that a few years before Bishop Aidass had leaned against the post. "It happened again, sometime after, that the same village and church were burned down the second time, and even then the fire could not touch that post." It was eventually taken inside the next church "as a memorial of the miracle." In the Anglo-Saxon chronicles there are many other records of large fires, notably of the total destruction of York in 741, Canterbury in 754, and London in 982.

It is somewhat remarkable that a really good complete history of the Great Fire of London has never been written. Of the numerous contemporary accounts of the disaster the best is to be found in the Diary of the all-observant, truthful Pepys. The fire began in the house of a baker in Pudding Lane, at a distance of 202 feet—the exact height of the column—to the eastward of the present Monument, late on the night of Saturday, or early in the morning of Sunday, the 2nd of September, 1666 (the *Gazette* of September 3rd, in its official announcement, says it commenced at two o'clock on the 2nd), and continued for four days; during which period it laid waste 400 streets, containing 13,200 houses, in addition to St. Paul's Cathedral, and eighty-nine churches. It also destroyed the following public buildings: the Custom House, Doctors' Commons, Fleet Prison, Guildhall (partly), Haberdashers' Hall, Royal Exchange, Zion College, Stationers' Hall, the north end of London Bridge (slightly), and the City Gates. Its progress was ultimately stayed by the blowing up of a number of houses in the direction of its lines of march. Its ravages extended from the Tower to the Temple Church, and from the North-East Gate to Holborn Bridge. This area embraced 436 acres. Out of the twenty-six wards in the City it destroyed fifteen, "leaving the remainder scorched, ruinous, and uninhabitable." The total damage resulting from the fire, as estimated by competent authorities, and including not only the buildings, but furniture and stock-in-trade, amounted to £10,716,000. This estimate included the value of St. Paul's Cathedral, which was set down at one-fifth the whole amount. Pepys, in one of his graphic notes, speaks of the horrors of the fire:—"Everybody endeavouring to remove their goods, and flinging them into the river, or bringing them into lighters that lay off; poor people staying in their houses as long as till the very fire touched them, and then running into boats, or clambering from one pair of stairs by the waterside to another. And among other things, the poor pigeons, I perceive, were loth to leave their houses, but hovered about the windows and balconies till they burned their wings and fell down."

A fire which assumed a real historical importance occurred one winter's night in February, 1709, at Epworth, in Lincolnshire, and was made the subject of a somewhat celebrated "centenary picture" more than a century later. The father of John Wesley occupied the rectory there, and at the time the founder of Methodism was but six years of age. He was sleeping in a room with three of his sisters, his infant brother Charles, then not two months old, and their nurse. About midnight his father burst open the door, and bade the nurse save herself and the children. She snatched up Charles, and told the rest to follow her, and escaped. The three girls followed her, but John was left in the room fast asleep. He woke in a few moments, and found the room so light that he called the maid to take him up. As no one answered, he just put his head out of the curtains, and saw streaks of fire on the top of the room. He then ran to the door, but could get no farther, as the flames were roaring outside. Finding all escape cut off, the boy ran to the window, and climbed on a chest which stood there. Meanwhile his father had discovered that John was in the burning house, and attempted to get up the stairs, but they were already on fire. Finding all attempts to save the boy were in vain, he knelt down in the hall and commended the child to God. Scarcely had he done so when John was seen at the window. A man in the yard proposed to bring a ladder; but another answered that there was no time. "Here," he said, "I will fix myself against the wall; lift a light man and set him upon my shoulders." They did so. John was taken out of the window, and just then the whole roof fell in. When the men brought the rescued boy to the house where his father was he cried out, "Come, neighbours, let us kneel down; let us give thanks to God; he has given me all my eight children; let the house go; I am rich enough."

St. Paul's Cathedral has, in later years, only narrowly escaped the fate of the earlier structure, and though Denham, the poet, writing of Wren's masterpiece, says:

> "Now shalt thou stand, though sword, or time, or fire,
> Or zeal, more fierce than they thy fall conspire,
> Secure, while thee, the best of poets sings,
> Preserved from ruin by the best of Kings;"

yet it was so seriously damaged by fire in 1803 that the restoration by Mr. Wyatt absorbed the sum of £42,000; and again in 1829 was it placed in jeopardy. More recently still, in the month of May, 1884, was the magnificent pile in great danger; in fact it was only due to the good order and celerity which distinguished the conduct of the London Fire Brigade, under the most trying circumstances of difficulty and danger, that the edifice was preserved. A fire occurred in Paternoster Row, and almost from the first the spectacle was one which, being seen, could never be forgotten. A dense, hurrying crowd seemed to spring up —east, west, north and south, hastening and surging towards the common centre of the Cathedral Church of St. Paul. The huge dome and western towers presented an extraordinary sight. All the south side of the vast outline appeared as if lost in mist, while the north face shone like white marble in a blaze of artificial light. For a time the excitement was intense, and the fire remained unsubdued, but the struggle between fire and water was fought out bravely—water winning slowly but surely a foregone victory.

There is something very remarkable about the narrow escapes which many of our noblest edifices have had from total annihilation by fire. If we look for the finest specimens of architecture which England can show we should naturally turn our attention to three great churches—to Canterbury Cathedral, Westminster Abbey, and York Minster. Yet it is a curious and rather uncomfortable reflection that each one of those splendid structures has been twice on fire since the commencement of the present century. Canterbury Cathedral, of whose architectural magnificence nobody who has visited it needs to be reminded, was almost burned to the ground about fifteen years ago. At the bare idea of the danger, which was then only just averted, a thrill of horror passed through the country; but thrills of horror are of no practical use as a fire-extinguishing apparatus, and despite all the reverence with which "English William's" church is regarded, the absence of an adequate number of fire-engines and a proper water supply was as nearly as possible fatal to the superb edifice on that occasion. It was found that the same cause was responsible for the outbreak which afterwards provoked the conflagration in which a great part of Warwick Castle was consumed. Workmen had been on the roof, and, with an utter disregard of their surroundings, had been using a brazier full of lighted coals, or some other easy instrument of destruction, in close proximity to exposed woodwork. Perhaps the fire in York Minster, thirty-seven years ago, was the most destructive which any of these sacred buildings have suffered in recent times. At that date the roof of the nave was burnt off, the interior of the Minster was seriously damaged, and the belfry reduced to a shell. Still earlier in the century, while labouring under religious hallucination, Jonathan Martin (brother of John Martin, the artist,) set fire to York Minster, inflicting damage to the amount of £60,000.

The churches of other countries have in earlier as well as later times suffered severely from fires, and unhappily the sacrifice of human life has been too often very appalling. Probably the most heartrending disaster of the century was the calamity at Santiago on the evening of the 8th December, 1863. The feast of the Immaculate Conception was being observed in the church of La Compania. At half-past six the temple was crammed to suffocation, and people still clamoured for admission. The staff of acolytes, who, it was said, had been busily engaged from two in the afternoon lighting the endless festoons of lamps, now reached the precincts of the high altar; all the tapers were safely lit, and there remained but to ignite a silver crescent containing paraffin, which had been placed at the foot of a large image of the Virgin. A careless acolyte, it seems, mismanaged the lighting of this, and the flame, rising to an extraordinary height, came in contact with the muslin and gold draperies round the altar. Quicker than thought all the contiguous decorations were in flames. For about one minute—only one minute—the congregation never moved, "evidently," as one contemporary chronicler wrote, "in the hopes that the hand of a merciful God would stay the conflagration." But the fire spread rapidly round the building, to escape from which was to those in the body of the church an impossibility. The first act of the gentlemen collected round about the doors and annexes was to attempt a passage through the densely packed throng of ladies into the centre, where many had left their wives and daughters. This was utterly impossible, and they had to allow themselves to be carried along in the stream of living souls that were making towards the doors. Once arrived in the open air, everybody, instead of moving away to make room for his neighbour, endeavoured to re-enter the building in search of some lost friend or relative. There were many ladies also about the annexes who, in ignorance of the true state of affairs, did not rise from their knees as quickly as they should have done for fear of losing their places, and the consequence was that those from the centre of the church pressing on towards the door stumbled over them; those next behind fell over these last, and in five minutes great walls, twelve feet high, of fainting, trampled and dying girls, entangled in each other's dresses, barricaded the only three exits that the church possessed, thus excluding from all outward help upwards of 1,800 ladies, who now saw themselves face to face with death. The fire made rapid progress, and the inside of the great dome was soon enveloped in flames. Drops of molten lead poured from above on the heads of the surging multitude, and the flames at length reached the festoons on which thousands of paraffin lamps were strung, and snapping the cords asunder dashed the coloured globes and their contents on the heads of the people, enveloping them in one sheet of liquid fire. Crash succeeded crash as the fire reached each pier, causing each festoon to give way, while from the crumbling dome above there descended a rain of firebrands and live cinders, scattering death and destruction all around. High above the roaring flames could be heard the piercing cries of agony, until about eight o'clock the loud and continued wailing within the temple became very faint. A few minutes after that hour a greater part of the roof fell in with a deafening crash, and then followed the silence of death. Thus perished in one short hour the flower, the beauty, the youth and pride of the capital.

Though the utmost order and discipline prevailed among the police and fire departments they completely failed in clearing the approaches to the doors of the church, while no power of water could ever have extinguished the mass of inflammable matter, such as gauze, velvet, muslin, tissue, ladies' veils, fans, and mantillas, saturated with paraffin, and thousands of pounds of wax from the melting and flaring tapers that flowed down the steps of the altar.

Feats of great valour and heroism were performed by many individuals on the spot. Lady Brassey, writing of the catastrophe, says, "Mr. Long told us that between seven and eight o'clock in the evening he was walking with some friends on the Alemeda when he saw smoke rising in dense volumes from the quarter of the city where the house in which he resided was situated. He and his friends ran quickly in the direction of the fire, giving the alarm as they went; and on reaching the church they found the doors closely shut, while fearful screams were issuing from the interior, and smoke and flames were pouring from the windows. They got a party of men together accustomed to the use of the lasso—no difficult task here—and with them climbed from the neighbouring houses to the top of the church. Making a hole in the roof, they then dropped their lassoes over some of the women beneath, and so dragged them out of the building; but the number thus saved was necessarily very small, and it happened too often that many of the poor creatures below, in their eagerness to escape, hung on to the legs or body of the one they saw lassoed, and by their weight literally dragged her to pieces. Sometimes even a lasso broke, and those clinging to it, when almost within reach of safety, were again precipitated into the burning mass below." Amongst other incidents, it may be noticed that Mr. Nelson, the American Ambassador, who was accidentally in the neighbourhood, hearing the tolling of the great bell, ordered his coachman to drive to the spot. On alighting from his carriage he rushed to the grand entrance, and arrived in time to witness the crushing and mangling of thirty ladies by the crowd from behind. He immediately set to work, and being joined by others was instrumental in saving the lives of about fifty young ladies. He never deserted his post at the threshold of the doors until the roof had fallen in, when a complete shower of sparks and cinders seemed to envelope him. He was carried from the spot with his clothes smouldering, and every particle of hair on his body singed to the roots. Two thousand souls were sacrificed in this horrible conflagration.

Charles VI. of France had a remarkable escape from being burnt to death in Paris in the year 1393. On the 29th of January, at a ball which was held in celebration of the marriage ceremonies of one of the ladies-in-waiting on Queen Isabella of Bavaria, and at which the King assisted with all his suite, a number of masked nobility entered disguised as bears, mixing themselves amongst the assembly of dancers. The Duke of Orleans endeavouring to identify the King, who was taking part in this masquerade, approached them with a lighted torch, and accidentally set fire to their skin, which was made of a very inflammable substance. The hall was immediately enveloped in flames and became the scene of terrible confusion. In attempting to make an exit many were crushed, cries being raised to save the King. The Duchess de Berry saved him from being burnt by wrapping him up in her dress.

Several hundred years later another ballroom catastrophe occurred in the French capital, attended unfortunately with more serious results, and at which a greater monarch than the Sixth Charles was a conspicuous figure. After the marriage of the Emperor Napoleon with the Arch-Duchess Maria Louisa of Austria, and on their return to Paris in June 1810, the Austrian Ambassador, the Prince of Schwartzenburg, gave a ball in honour of the event, at the Austrian Embassy. The ground floor of the ancient Hôtel de Montesson which he occupied, in the Rue Chausée d'Antin, was not large enough to hold the company invited. The Prince therefore had a superb ballroom constructed of wood in the garden, with a gallery of the same material leading to it, the veilings of which were covered with varnished paper, and ornamented with paintings. The floors were connected by planks of cross timbers to the level of the rooms of the house, and an immense chandelier was suspended from the ceiling of the ballroom. Candles were also used in the illumination of the walls of the gallery and the ballroom. In the centre of the room was a box reserved for the Imperial family. This faced the entrance from the gallery, and there was a private door close to it for the use of the Emperor and Empress. The fête commenced with dancing in the garden, which was splendidly illuminated. The dancing had continued about an hour when a current of air blew one of the curtains at the entrance to the wooden gallery across the lighted candles, which had been fixed too near. In a moment the ceiling of the ballroom was in a blaze. The Emperor and Empress escaped with ease from the danger by the door which had been left behind their box. Napoleon made the carriages draw up, saw the Empress as far as the Place Louis XV. on the way to St. Cloud, and returned to assist in extinguishing the fire. The flames had made terrible progress; the chandelier suspended from the centre of the ballroom fell with a tremendous crash, and in the hurry and the fright, the crowd pressing towards the entrance stopped up the passage, and with this collected weight the floor gave way, and numberless victims were crushed to death or enveloped in the flames which burst out on all sides. In a very short time—a briefer space than it takes to tell the tale—the temple of gaiety and enchantment was no more. Meantime Napoleon busied himself in directing the efforts of those devoted to the work of rescue, and himself ran terrible risks in snatching from danger ladies and children who were in a frenzy of despair. He had just rescued the children of the Princess of Schwartzenburg, when suddenly Her Highness, handsome, elegantly dressed, and covered with diamonds, rushed forward from the smoking rafters calling out for her little ones. The apparition vanished as soon as it was seen, and Prince Schwartzenburg, deprived of his amiable wife, never recovered from the effects of his loss.

Paris also has an unenviable reputation for the fires that have occurred at its places of amusement, and notably at its Opera Houses. In addition to the five fires, somewhat exhaustively recorded by Captain Shaw in his pamphlet on "Fires in Theatres," and which occurred within a period of 110 years, there was the lamentable catastrophe of the spring of 1887 at the Opéra Comique. On the occasion of the fire at the Opera House on the 8th of June, 1781, the public had left the theatre, and the people who had danced in the last ballet were quietly undressing in their rooms, when on a sudden cries of anguish resounded on the scene. For the second time in eighteen years fire was going to devour the Opera. An ill-timed and unreasonable fit of modesty imperilled the life of La Guimard. Almost without clothes in the room where she changed her toilet, she did not dare to leave, and was on the point of being suffocated, when a machinist had sufficient presence of mind to roll her up in the curtains and carry her out. Beaupré killed himself jumping from the third floor. Castil-Blaze made a dramatic episode out of the death of little Vidal. "Huart, a vigorous dancer and a tall man, having only two floors to jump, made towards the roof of a shop, slid into the Cour des Fontaines, and fell on his feet without hurting himself. His valet, a boy of fifteen, was at the window, and did not dare to throw himself out of it. Huart stretched his arms to him, called him, encouraged him, saying that he was ready to receive him, and to ward off the blow from him. Nothing could decide this unfortunate boy, not even the fire, which soon reached him and burnt him alive under the eyes of his master." Most of the dancers took flight by the tops of the neighbouring houses, jumping from gutter to gutter, and precipitating themselves into the street.

The fire of 1887 was a most appalling disaster. It occurred on the night of the 25th of May, and originated on the stage of the Opéra Comique during the performance of *Mignon*. The actors endeavoured to reassure the audience, but they had scarcely spoken when the stage seemed enveloped in flames, and the actors, orchestra, and spectators fled in terror. There was a sad death-roll of persons either burned, suffocated, or crushed to death, and there were some remarkable instances of escapes. Among those in the theatre at the time of the disaster were M. Guibord de Luzinais, senator for the Loire Inférieure, his wife and daughter, and next them M. Le Cour, a deputy, his wife and sister-in-law. Just before the alarm was given, Madame Le Cour, seeing some sparks fall on the stage, rose from her seat and said to her husband, "Let us go out quickly, I do not feel well." M. and Madame Le Cour then went out. They had scarcely reached the cloak room when a frightful rush was made. An immense crowd filled the passages, screaming and pushing each other wildly. Among them was M. Guibord. His wife fainted, and he seized her in his arms and carried her to the verandah, where he found his family, and a number of ladies, who had sought shelter there. They were all wildly screaming for help. The crowd outside cried to them to wait, and they would all be saved. Assistance was at hand. At last a fireman came with a ladder, but it was found to be too short. A rope was then thrown, by which M. Guibord was able to save his wife and daughter, and other persons, and he was the last to come down the rope himself. There have been many theatres destroyed by fire in England—indeed, the list is far too long to recapitulate here—but the most serious of all these disasters was the one that occurred at Exeter in September, 1887, when not less than 150 lives were lost, under circumstances only too well remembered.

Another great fire in Paris, which was remarkable for the great pluck and daring of the firemen, was that which occurred on the 9th of March, 1881, at the Magasin du Printemps, near St. Lazare Station. When the first hand-engines arrived, the flames had been raging for more than an hour, and their violence was so great that the pumps were not only unable to arrest them, but were scarcely sufficient to preserve the neighbouring houses. It was not till two hours and a quarter after the fire broke out that the steam fire-engines arrived. The firemen, assisted by the military, worked nobly, utterly regardless of personal danger. Three hours after the arrival of the men, four had been grievously wounded. One man, named Havard, fell from the first floor into a mass of burning wood and carpets. His comrades rushed after him, and at the risk of their lives, and with much damage to their own persons, dragged him out. His clothes were blazing on him, and could not be removed without taking off all his skin. To comfort him his colonel assured him that he had won the red ribbon, and that it would be given to him. The poor fellow, however, died in a few moments. There were no fewer than twenty-six firemen more or less wounded on this occasion.

America—always notable for its "big" things—is remarkable for the most gigantic fires. From the time of the Negro Plot in 1741, when the first great fires occurred in New York city, to the present day, the catalogue of such catastrophes in the New World has exceeded in extent and horror the record of any other portion of the civilized globe. Whole cities have been destroyed, and it is truthfully recorded of the American firemen, as in fact it may with equal truth be asserted of the English brigades, that the perils to which they are frequently subjected, and the courage with which they are faced, are scarcely inferior to the dangers met with, and the courage evinced, by brave soldiers on the field of battle. If statistics were carefully compiled it would be seen that the loss of life and personal injuries sustained by the trained corps that day and night guard the principal cities of England and America from fire, would probably more nearly approach the proportion usually killed and wounded in active military campaigns than we could easily believe. They are a noble though a small army, and they often perform heroic deeds that merit a higher reward than the praise bestowed by the chronicler who records the story. This inherent heroism has often been manifested by men and women unconnected with the organized brigades. During the year 1803, when flakes from what is known as the "Timber Yard Fire" in New York, were blown on to St. Paul's Church steeple, despair was depicted on every countenance, for the wind was high, and as the steeple took fire the whole city was threatened with destruction. But a gallant sailor came forward, and volunteered to climb the lightning-rod, taking with him a cord, which he made fast at one end, and let it down to the ground. A bucket was then tied to it, and being filled with water, and a tin cup placed in it, was hoisted up to the noble fellow, who, holding on a column with one hand, used the tin pot with the other to cast on water. He thus extinguished the fire in the highest part of the steeple, and saved the city. What was the hero's name?

Similar daring was exhibited in 1811 when Mr. McCormick saved the lower part of New York by climbing a church steeple, and extinguishing a fire by cutting off the burning parts with an axe. The burning of the City Hotel, New York, on the 24th of April, 1833, was rendered notable chiefly for the lives saved by Chief Engineer Wenman. Soon after it was known that the roof was on fire eleven persons went up to render assistance, and while they were engaged in arresting the progress of the flames, the greater part of the ceiling of the upper story fell, and cut off their retreat. Wenman, with an axe, cut away the skylight, and a fireman beneath was enabled with the assistance of a flag-staff to send up the end of a drag rope. Wenman commenced lowering down his companions, and after all of them had been relieved, he was enabled to descend himself, sadly wounded and burnt, and only just in time to escape from the collapse of the building, which immediately followed. At a fire on the 18th of November, 1848, the flames communicated to several small wooden buildings in the rear of Seventy-Eighth Street, occupied by poor families. Women were running in every direction seeking their children, and children were seeking their parents. One woman, supposing her child was still in her burning dwelling, with the frenzy of despair rushed into the house and ascended the stairs to the second story, but the heat was so great that she was forced hastily to retreat. The child had been left, but a fireman shortly appeared at the window, bearing in his arms the object of the distracted mother's search. In a moment more the baby was in the arms of its mother, who shrieked with joy, and in an ecstasy of wild delight fell upon her knees and called down the blessing of Heaven on the deliverer of her babe. Two years after this incident an affecting episode was witnessed at a fire in Hayne Street, New York. The broken and crumbling masonry, the heavy beams, and unwieldy pieces of iron-work had buried many of the firemen, including a youth but fifteen years of age, by name Samuel J. Tindale. Young Tindale was discovered, on the removal of some of the débris, lying upon his back, his head, trunk, and one arm comparatively uninjured, his right arm and lower limbs wedged fast, one leg held immovable by a heavy bar of iron. Upon him lay large masses of bricks, timber, and other material, while the iron bar, heated by the fire beneath, burnt the flesh off that leg till the bone was bared. But the little hero did not complain. Streams of water were thrown upon him until he was in danger of being suffocated. He not only cheered the men who were endeavouring to extricate him, but spoke encouragingly to his unfortunate fellow victims close by. He was taken out of the ruins ultimately, but the poor boy was past all human aid, and his brave spirit departed four hours after his release.

What, however, is recorded as the noblest act of heroism in the annals of the Fire Department of New York, was performed on the 17th of March, 1852. A fire in a paper-hanging store cut off the retreat of some men, women, and children who lodged in the third storey, and whose cries for deliverance were very piteous. A ladder brought from a neighbouring paint shop enabled two men to escape; but as its top was several feet below the windows of the third storey, the women and children were unable to reach it. James R. Mount immediately obtained a barrel, caused the ladder to be lifted and set upon it, and mounted the frail structure "raised upon a tottering base," and by an effort almost superhuman rescued two adult females and two children. When the feat was accomplished Mount fainted, and was taken home. This gallant fireman subsequently rescued several persons under similar circumstances in 1860. On the day that Barnum's Museum was burned (July 13, 1865), a fire consumed several houses in the vegetable gardens which then abounded in Bloomingdale. During its progress a woman with a child in her arms appeared at an upper window, and appealed for help. No "hook and ladder" company had yet arrived, and there was no time to get a ladder, but several of the firemen hastily adopted a unique and successful method of rescue. One of them climbed up the front of the building by the windows until he reached the room in which the woman stood. Another, held by a comrade, stood in the window below. Two others stationed themselves in the window on the lower floor. Others still in front of the burning building held a bed upon which the woman and child might fall. The child was safely passed down from one to the other. Then with more difficulty the woman was lowered to the ground in similar style.

American hotels are among the class of "dangerous structures" which are regarded as being especially subject to destruction by fire, and of the numerous disasters of the kind during many years, probably the burning of the Southern Hotel, St. Louis, was the most terribly unique. The fire broke out at half-past one o'clock, in the morning of the 11th of April, 1877, and in a few minutes the windows on the top floors began to swarm with men, women, and children, shrieking piteously for aid, which it seemed almost impossible to give them. Several were rescued by ladders on one side of the hotel, but on the other the windows were out of reach, for the building was six stories high. The density of the smoke in the hall drove back many of those who tried to reach the windows by which they might have escaped, and others wildly threw themselves out of other windows to certain death beneath. Men and women, fainting and raving, were lifted on to the ladders, and carried down in their night clothes in the strong arms of the gallant firemen. The Skinner fire escape was instrumental in saving some, and the happy thought of placing ladders on the two-storey balcony on the north side, too, was the means of saving a few of the people in the upper stories. Mr. Peter Blow, a son of the ex-Minister to Brazil, was one of these. He was sleeping in a room on the sixth floor when the fire broke out; he rushed to a window, from which he dropped, sustaining a broken arm. Two other men dropped from a third storey window, and were instantly killed. Five women were rescued from the sixth storey on the Fourth Street side by the firemen, who ascended the ladders and threw ropes to the half-crazed creatures. Several inmates tore up the bedding, and in this way escaped. Miss Kate Claxton, who was lodged in the third storey, had returned from the theatre but a short time when the fire broke out, and had not gone to sleep. With great presence of mind, and profiting by a previous experience she had had of fire, she wrapped her head and face in wet towels, and walked and rolled downstairs into the street and to safety. Perhaps the most touching incident of the fire was the escape and subsequent fate of Mr. Felix William Munster, formerly M.P. for Mallow. He and his bride, to whom he had been married only three months, were returning from their honeymoon in the south, and were staying at the hotel on the night of the fire. Their rooms were on the fifth floor. Alarmed by the noise outside, and realizing their position, they hastily dressed themselves and attempted to escape by the halls. The smoke stifled and blinded them, and they were forced to return to their room. There seemed to be no hope for them, and Mr. Munster proposed that they should die together by a revolver rather than be burnt to death. At this moment the door was burst in by a fireman, who seized Mrs. Munster, and rushed with her through the halls; Mr. Munster followed, and both escaped. Subsequently, Mr. Munster, in company with a Mr. O'Donovan, visited the fire, and recalled the scene of death and suffering. Mr. Munster seemed to be greatly depressed, and returning home shot himself. Amongst the many persons who had distinguished themselves by their gallant efforts to save life during this fire was a "gentleman gambler," Mr. Charles Tienan. He was dealing the cards not a stone's throw from the hotel when he heard the cry of "Fire!" Dropping the cards he elbowed his way through the crowd in front of the burning structure. The shrieks of the women were more than he could bear, and springing almost into the flames, he rescued first one helpless woman and then another. He was terribly burned, but the screams still continued, and he plunged once more into the fiery furnace, only to meet his own death.

As a final instance of a wonderful escape in New York, may be given one that occurred early in 1882. A portly man was imprisoned by fire and smoke in the fifth story, and there were no ordinary means of reaching him. The adjoining house was smaller, its roof reaching about half way between the fourth and fifth storey windows of the burning structure. A fireman reached this roof with a small ladder, but he found it impossible to get to the fifth floor. He, however, put the short ladder on the window sill of the fourth floor, and held it flat against the building, so that it would reach the storey above, and on this support the man whose life was endangered descended. The men were now together, but not out of danger. The ladder was next put with one leg on the sill but aslant, so that it would reach over to the adjoining house. Held in this position by the fireman at one end and volunteer assistants at the other, it formed a very dangerous, but as it proved successful, means of escape for the man whose life was in peril. The fireman was now left alone, but escaped by the same path, trusting entirely to the grip of the men at the top of the ladder. All this was done at a height of thirty or forty feet from the stone sidewalk, in the midst of the excitement attending a great fire.

Nothing has ever occurred in England to vie in magnitude with the fires of America since the Great Fire, already alluded to; but the chronicles of our fire brigades bristle with tales of escapes equally wonderful, and rescues none the less heroic than those already enumerated. The Royal Society for the Protection of Life from Fire, by its periodical rewards for bravery, has stimulated courage and daring in the work of rescue. Firemen, police constables, labourers, and women have all been included in the recipients of the Society's awards.

On the 11th of June, 1876, a fire took place in the Mile End Road, London, and when Fireman William Rhymes arrived at the place the building was enveloped in flames. Placing his escape at the second floor windows, he ascended, and carried down two children, one being a cripple. He reascended and enabled three other persons to escape from the burning building. In the same month, a civilian and a police constable rescued as many as seven persons from a burning house at Stepney. George Lee, of the Metropolitan Fire Brigade, died on the 17th of August, 1876, in consequence of severe injuries received at a fire in Clerkenwell. Lee was a fire-escape attendant, and having rescued a person from the burning building, re-entered the second floor of the house, and in extreme peril succeeded in bringing out of the fire a young woman, herself severely burnt. He reached his escape so exhausted that he had to be taken off the ladder, and after severe suffering expired. On the 18th of October, 1877, a disastrous fire broke out in a back room of one of the poor lodging-houses in Holborn. The alarm was first given to Policeman Goscomb, who immediately took steps to rescue the inmates—a task of great personal danger, owing to the rapidity with which the flames spread. Having sent for the engines and the fire escape, Goscomb proceeded to the second floor, where he found a woman and her daughter, suffering from rheumatic fever and completely bedridden. These he succeeded in saving, and then directed his attention to the other inhabitants of the house, who by this time were in a state of the utmost distraction and alarm. Placing a long ladder against the third floor front window, the constable gallantly mounted it, and having passed the first and second floor windows rescued an old woman who was all but suffocated, and then returned for her husband, who had been completely paralyzed for some years, and was unable to help himself. Small wonder that when Goscomb again reached the ground with the difficult burden of the aged and infirm husband, he was greeted with hearty cheers. Another fire in Holborn nearly three years later was the occasion of an exciting scene. Just as the engine was preparing for action the figure of a woman was seen at an upper window of the burning house, and her rescue was left to the unaided exertions of the fire officials. Room was made for the fire escape, and the firemen mounted the ladder amid a blinding column of smoke and a sheet of lurid flame. One by one seven children who were in the burning chamber were handed down, and last, the patient, terrified mother was brought safely to the ground. Then the men, having risked their lives in the service of their master, the public, unconcernedly took a turn at the less dangerous duties of their calling, and another fireman was told off to crawl up a chimney of a neighbouring house to turn off the gas at the meter at the top of the burning building, at the hazard of being blown to atoms! These are ordinary incidents in the lives of our commonplace heroes, who would not be accused of vanity if they took for their motto that of the Chevalier Bayard, "Without fear and without reproach."

Royalty on one occasion decorated a fire hero. At the conclusion of the Wimbledon Rifle Meeting of 1880, and just before the distribution of prizes, the Princess of Wales pinned to the breast of Captain G. Fred Harris the order of St. John of Jerusalem, awarded him for saving lives at a fire in Dublin. The fire took place on the 19th of September, 1877, in Charlemont Street, and Captain Harris rescued five persons, besides removing, alone and unaided, at still further risk, a quantity of paraffin oil from the premises, and so preventing the fire spreading to the adjacent house, which was a female orphanage.

The destruction of the Southhall Lunatic Asylum, on the 14th of August, 1883, was a terrible scene, and taxed the efforts of the firemen very sorely. Ladders were procured to rescue the inmates. Some of them resisted being taken out of their rooms, and it was only by the exercise of force that they were rescued alive. One patient, an elderly female, proved exceedingly obstinate—so obstinate that even when she had been placed on the ladder she clambered back over the window-sill into the room. By dint of the most courageous efforts all the inmates were got out safely except the proprietor and his son, two patients and the cook.

A singularly striking instance of fidelity to duty, and of presence of mind, under circumstances which destroy all self-possession in many men, was given during a fatal fire which took place in London on the 24th of April, 1885. The shop of an oilman took fire in the early morning, and in consequence of the inflammable nature of the stock, the fire burned most fiercely. The proprietor, his wife, and a little boy all perished in the flames; but a nursemaid, Alice Ayres, who was in charge of three little girls, and who could easily have saved herself alone, with some difficulty threw out of the window a feather bed, and threw each of the little girls into it, finally jumping herself, but not till the heat and the smoke had so confused her brain that she missed the bed, and dislocated her spine on the pavement. She died in Guy's Hospital; but her heroism is perpetuated in the monument erected over her grave. A few months afterwards a young girl named Mary Ann Charles imperilled her life by dashing into a burning house at Bermondsey, and rescuing a little baby which had in the hurry and excitement been left behind by its parents. On the 19th of August in the same year a fire occurred in Rochdale which excited a great deal of public interest and generosity on account of the bravery of a fireman and his dog. The scene of the fire was a hosier's shop, and it was discovered about two o'clock in the morning. Some of the inmates were enabled to escape by the doors and windows; but two children remained in one of the bedrooms, and there was apparently no chance of saving them. Fireman Cragg, however, ascended the stairs, and guided by the moaning of his retriever dog, he groped his way to a bed on which one child was lying nearly suffocated. The fireman took the child down the stairs, but became overpowered by the smoke and fell down about half a dozen steps. He, however, retained his hold of the child until he had placed him in safety, and bravely returned to rescue a boy who was seen at the window sill. He brought him down with difficulty, and then the noble fellow, notwithstanding acute suffering from injuries, resolved to risk something to save his dog. He went upstairs for the third time and found the dog lying quite helpless in the bedroom. The humane fireman took the bulky creature into his arms and conveyed him safely to the ground.

The remarkable instinct shown by Fireman Cragg's retriever recalls a few incidents in connection with fire-dogs. One of the boldest and bravest of the London Fire-Escape men, who saved nearly one hundred men, women and children from the flames, had a wonderful and faithful companion in his dog "Bill." Samuel Wood and "Bill" are writ of in song, and their memory is green in the neighbourhood of Whitechapel, where for so many years the two heroes sojourned together. Around Bill's neck the inhabitants of Whitechapel placed a silver collar in token of his valuable service during the nine years that he had filled the important post of the Fire Escape Dog. Bill, like his master, had to be very wakeful, and at his post of duty during the whole of the night. In the day he slept by his master's bed. He knew the time to get to his post, and when the escape was wheeled out of the Whitechapel churchyard at nine o'clock the dog was promptly on the spot. At an alarm of fire Bill would bark furiously, and Wood had no occasion to sound his rattle as the police round and near knew the bark well. In dark nights the lantern had to be lighted, and Bill would at once seize it and run on in front of his master. When the ladder was erected Bill was at the top ere Wood had got half way, and the sagacious brute used to jump into the rooms, and amid thick smoke and the approaching flames would run from room to room, helping his master to find and bring out the inmates. On one occasion the fire burned so rapidly, and the smoke in the room became so dense, that Wood and another man were unable to find their way out. They feared that escape was now hopeless; but Bill seemed to comprehend the danger, and began to bark. Half suffocated, Wood and his comrade, knowing this to be the signal "Follow me," at once crawled after him, and in a few moments they reached the window. Another useful dog was "Bob." Whenever the fire-bell rang at the old Southwark Fire Brigade station, none was in a greater hurry to be off than Bob. He ran before the engine and cleared the way, and would run up ladders, jump through windows, and enter dangerous rooms more quickly than any of the firemen. Bob was quite a gallant. He rescued a cat from the flames in one instance, and carried pussy very carefully to a place of safety. In another case of fire in the Westminster Road, the firemen thought that all the inmates had been got out of the house; but Bob knew better. He kept barking and scratching at a small door, and in spite of being ordered away by the firemen persisted in his barking. "There's some reason why Bob makes this ado," said one of the Brigade, "let's break open the door." This was accordingly done, when the astonished firemen found a little child, who but for Bob would have been burnt to death. Dogs unattached to any brigade have sometimes been known to exhibit a very accurate acquaintance with the dangers of fire, and much cleverness and devotion in overcoming them. Mr. J. E. Walter, the master of the train service of the Louisville and Nashville Railroad owned a valuable Newfoundland. His little daughter was very fond of the animal, and some time in 1886 the girl was left in a room alone by a large fire in the grate. She went too near the blaze, when the dog went to her and began to pull her away by catching her clothing in his teeth. The two companions played about the room for some time until the little girl grew tired and sleepy and lay down in front of the grate. The dog, it is supposed, pulled at her clothes for some time, but could not arouse her. He then hurried to her mother's room, and, began to act strangely by rubbing against her hand, and catching her dress, pulling her towards the door. She caressed him and told him to go away and find Nellie. He made a strange, whining noise with his mouth, and then slowly walked back to where the little one was sleeping, unconscious of her great danger. The dog made another attempt to rouse her and failed. He then crouched down beside her between her and the fire, taking care to protect her well. Mr. Walter entered the room a few minutes later and found the dog in this position, whining and crying while the hair was being singed from his back. A writer in *The Fireman* records that Mr. W. F. Bond, proprietor of the Badger State House of Waterloo, Wisconsin, has a dog-fireman, if such a thing lives. The animal persistently puts out the lighted cigar ends thrown down by gentlemen, "and never fails to put out a coal of fire when it falls upon the floor." Once the hotel was saved from destruction by the commotion he created when he found a fire too big for him to manage.

Many are the authenticated anecdotes about fire-horses. "Our Brice" was a celebrated and sagacious horse attached to the Manchester Fire Brigade, whilst a New York Company had a horse which knew the stations on which the company performed duty. Whenever the gong sounded an alarm he ran to his place and snapped his polesnap to a ring in a strap for that purpose. Upon the sounding of the gong for other stations striking more than two blows, if the man on house patrol did not stop him he would pull the bunk-room gong, and as the men came tumbling downstairs he would neigh with satisfaction at having turned them out of their beds. "Toner" was the name of a noted fire-horse in Chicago. He was always on the alert, and seemed to know as much about the business as the firemen themselves. He needed no urging on with the engine, he strained every nerve, and had worked out eight other horses in the same number of years. There was something touching in Toner's death. When the alarm came in he bounded to his place and was impatient to be off. Once in the street, he shook his handsome head and broke into his regular gait. Faster and faster flew the hose carriage ahead of them, its lamps swaying and jolting as they rolled along. As he saw the glare of the fire he redoubled his efforts until the steamer seemed scarcely to touch the pavement. Nearer and nearer they drew to the fire and finally pulled up at the hydrant. Toner answered every command, every touch on the lines, until the steamer was in place, and then giving a sort of sigh, dropped dead in the harness. Horses having once done duty in the fire service rarely lose afterwards the impressions made upon them during their fire-brigade career. A horse which had become aged in the service was taken to an auctioneer to be disposed of. The old nag passed through several hands, and at length became the property of a "refuse" cartman, who by chance went to the engine-house one day to cart off the garbage. Cart and all had been backed up to the pit in rear of the building, when suddenly the gong sounded an alarm. At once all the old instinct of the animal stirred in him. The worn-out hack felt the fire of years before, and away he dashed, carrying with him a section of the stairway, and almost smashing to pieces the engine that was in his way. A milkman once bought one of these horses, and found him a very docile and well-behaved animal. One day the owner was serving a customer when the engines came thundering along. The peaceable and sedate brute heard the rumble and could not contain himself. The first glimpse he caught of an engine sent him wild, and away he tore with waggon and milk cases clattering behind him. It was a long run for the owner, but he never caught sight of the runaway until he reached the fire and saw the horse there, quietly standing in the full glare of the flames.

PART III.

THE RISKS OF TRAVEL AND INDUSTRY.

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RISKS OF TRAVEL AND INDUSTRY.

CHAPTER X.

THE INFLUENCE OF MACHINERY ON MODERN LIFE.

MECHANICAL invention has effaced the quietude of ancient days from the lives of the people, and by multiplying the processes of material production has brought within the command of the humblest articles and commodities which during the long centuries when hand labour ruled our industries were beyond the reach of even the highest. The change has been rapid and marvellous. In little more than a century the world has passed from a semi-pastoral condition of existence to a state of restless activity and high-pressure which is typical of the pantings of steam and the whirlings of wheels which have on all sides encompassed us. Such a revolution could not possibly be effected without evil results as well as good, but the balance has clearly been on the side of the better influences, for, much as old-fashioned people, who have not moved with the times, may deprecate the turmoil and excitement of modern mechanical methods, they themselves would not like to relinquish the benefits which machinery has conferred upon them. Besides, the more serious disadvantages of the system of production and motion which in the first rush of the steam era were allowed to develop have for the most part been removed, and it is probable that the millions who gain their livelihood amidst the clatter and buzz of looms and spindles, or the flashings of flame and the clangour of hammers, enjoy, all things considered, brighter lives than did the workers in the handicrafts of the olden time. The terrors which attended the factory system when greedy cotton-lords and worsted-princes were uncontrolled in their tyrannies, and were allowed to make their fortunes at the cost of human suffering, have long been minimized by legislative interference; in the same way, the dangers that once beset these toilers from unprotected machines have been to a great extent guarded against; and, altogether, this large body of workers may be said to have realized as much of the dignity and independence of labour as is consistent with the ordinary conditions of industrial service. Then, apart from these considerations, there are the broader issues involved in the effects which our various mechanical developments have had upon society generally, increasing the avenues of approach from the lower levels of existence to the higher, and giving opportunities which otherwise would have been unknown, of winning wealth by skill, ingenuity, and energy. Machinery has caused the old lines of demarcation between class and class, between the multitude and the aristocracy, the many and the few, to merge one in the other, until it is difficult to say where the commercial link begins or ends. Machinery has converted England into an industrial El Dorado, far richer in prizes for the adventurous and enterprising than any of the lands of golden dream which proved so great an attraction to the gallant spirits who ventured forth over southern seas in the early days of maritime discovery.

Travelling on sea and land has been rendered so easy by mechanical invention that time and space have no longer to be reckoned with as of old. On sea, science has done much for the mariner, but machinery has done more. The sailor certainly has at hand a score of scientific appliances of exquisite accuracy. He has the leads which sound the depths whilst his ship speeds along fast as a gale of wind can blow her; chronometers of incomparable excellence; sextants which leave the imagination nothing more to invent in their way. But without the steam pumps, the steam windlasses and the machinery aloft, the vessel would be no better off than those of Anson's squadron, or one of Pizarro's galleons. The subject of steam navigation, from a mechanical point of view, is not easily exhausted. Our American cousins claim to have been the first, with the side-wheel steamer *Savannah* in 1819, to have accomplished the journey across the Atlantic. Previous to 1818, in fact, there were few who possessed the courage necessary to take an ocean trip of very great extent in steamers that had been built for inland purposes. The time had arrived, however, when river steamers in America had ceased to be a curiosity, and the sea—that great highway of all nations—invited the attention of inventors to its vast domain. The voyage of Stevens's vessel, the *Phœnix*, from Hoboken to Philadelphia, is spoken of as the first ocean trip in the world's history. Shortly after this, a number of vessels were built and ran regularly as packets in the coast trade both in America and Great Britain. The *Savannah* had been intended for a sailing vessel, but at the suggestion of Captain Moses Rogers she was bought by a company and fitted with a steam engine and paddle-

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wheels, which "folded up like a fan, so that they could be disconnected and hauled on deck when not in use, as in case of a storm or when they were short of fuel." On the 26th of May, 1819, she started from Savannah for Liverpool under the command of Captain Rogers. She began the voyage with seventy-five tons of coal and twenty-five cords of wood, and the passage was made in twenty-six days—eight under sail and eighteen by steam.

As is almost always the case with enterprises requiring a very large capital to develop them successfully, the process of development was slow with the early transatlantic steamship lines, and nothing was done in this direction until nearly half a score years had elapsed from the time of the voyage of the *Savannah*. The trade of the cities of Amsterdam and Rotterdam with the West Indies as early as 1820 had become very important, and the merchants of these two cities were frequently discussing the subject of their losses by the wreck of vessels engaged in this trade. The voyage of the *Savannah*, her speed and seaworthy qualities, were often referred to, but nothing was done towards an experiment in ocean steam navigation until 1827, when a company was formed and an order given to a ship-builder on the Clyde for a steamer of three hundred tons, with an engine of one hundred horse-power. This vessel was called the *Curaçoa*, and it steamed out of the harbour of Amsterdam, bound for Curaçoa, in August 1829. She arrived at the latter port after a voyage free from accidents of a serious nature, and afterwards made a number of other trips, but on account of the imperfection of her steam machinery it was necessary to carry and consume so much fuel that she was pronounced a failure, and was discontinued in this service in 1831.

The third transatlantic steamer was the *Royal William*, built at Quebec and taken to Montreal, where she was provided with side lever marine engines. She also was a failure on account of the large quantity of fuel required, which consumed all the profit on the small amount of freight and few passengers she was capable of carrying.

Lapse of time, and the simultaneous development of commercial enterprise, rendered a more rapid and safer system for propelling vessels necessary in order to keep pace with the changes that were continually occurring in all the great industries of the world. The introduction of steam upon river vessels, and the almost marvellous changes that had occurred within a few years by its introduction for propelling land carriages, seemed to stimulate the energy of both inventors and capitalists in Europe and America. Hitherto, transatlantic steamers had been of small tonnage; larger ones were necessary, and with improved machinery. Money was equally necessary, but this was raised, and eventually the *British Queen*, 2,400 tons, made the run from London to New York in July, 1839, in fourteen and a half days. Since that date oceans have been bridged in all directions by steamships, and the progress made in their invention, and their effect upon modern life, have not been less remarkable than that occasioned by the extraordinary development of railways.

Machinery, in its more exclusive province, has exercised an undoubted influence for the general good, though its first introduction created serious disturbance. It was feared that the working man would be annihilated. The greater part, however, of the "cancelling of labour," as it was called, eventually worked for the benefit of the labourer. Those who thought their occupation taken from them, and who, in the first outburst of alarm, broke into riot and destroyed machines, were in fact quarrelling with a power that was to do infinitely more than any other for the elevation of their class. The cost of production was cheapened by machinery, but the more valuable and complicated the machine, the more delicate was the trust reposed in the person by whom it was worked; the more carefully was he selected, and the better he was paid. Depressed markets forced the manufacturer to cheapen the cost of production, and he did so by placing additional mechanical power under the care of his workmen. Still, in doing so, he had to exercise double care in the choice of able and trustworthy servants, and had to make a considerable addition to their wages. No doubt a temporary lessening of the number of hands employed at the lowest rate of wages was the immediate result, but a permanent demand for improved labour at an improved price was established. Production having been cheapened, the price of the article produced continued to be low, and by the lowering of price there was obtained an increase of demand, which very soon brought up to the old scale the number of men occupied in the business of producing. Thus there was work for the old number of hands, and usually for some new hands too, while there remained the fact that an improved class of workmen was instituted—that so many men, who might otherwise have remained near the bottom, went up a step or two higher in the social scale. This is as certainly the case when cheapness has been obtained by improvement of machinery, as when it has been obtained by a direct call for improved labour. Nor was this the only benefit to the working man. A better kind of labour being produced, prosperity was increased and rendered more durable to the workman as well as to the master. The latter, recognizing the fact that skill was all the more necessary in the men he employed, became reluctant even in times of depression to disperse his staff. Mere hand labour could be picked up in the street, but a man who had secured the service of skilled labour exactly suited to his wants, would endure much inconvenience rather than run the risk of losing its assistance. The more valuable the machinery, too, the more important it became that the capital represented by it should not be left altogether idle; that what was meant for an investment should not be transformed into a debt—a class of property upon which interest is paid instead of made. As to the general effect on labour of the increased use of machinery, it may appropriately be mentioned that, in 1792, it cost a shilling with the machinery then used to make a pound of yarn; fifty years later, the cost was only twopence. Of the one sum the labourer received as wages fivepence-halfpenny on every pound of material; of the other, he received only a penny, and yet in the former period the weekly wages were four shillings and fourpence, and in the latter eight shillings and eightpence, earned chiefly in each case by women and children. The cost of production, of course, has still further lessened with the development of machinery, and wages at the same time have risen.

As evidence of this we may take especially the lace manufacture. The lace knitter upon the pillow can weave perhaps five meshes in a minute, and can make a square yard of plain lace in six hundred hours. Early in the present century the plain lace-making machines at Nottingham, then a yard wide, made a thousand meshes in a minute, or a square yard in two hours. What formerly took so many hundred hours to make is accomplished now in less than five minutes, and the result has not been the destruction, but the creation of livelihoods. In the first ten years of the nineteenth century the finished prices of plain net were sold at more pounds per yard than pence to-day. When lace was a luxury, which but few people could afford, there were high profits obtained, doubtless, by a very few producers, but later, when it became a distinct article of consumption, it caused the distribution of millions of pounds in wages to two or three hundred thousand people. The rate of wages on both plain and fancy lace machines rose rapidly, and who, then, shall regret that the use of the lace pillow, or any other manual work that consisted merely of incessantly repeating the same action, has been superseded by mechanical contrivance?

Machinery has also worked remarkable revolutions in connection with our food supplies. Agriculture has benefited very largely from the inventive genius that has contrived to supplant cumbersome, and rough-and-ready methods, with precise and scientific mechanical processes. There are tools and machines for breaking up and stirring the ground; machines for sowing seed, from the hand dibble to the drill, in all its varieties, dry and with water, with chemical manure and without, in lines and broadcast, for the flat and the ridge, for plains and for steep hills. There are dozens of different kinds of corn-reaping machines, and an endless variety of contrivances moved by hand, by horse-power, and by steam, for thrashing out, collecting, cleaning, and sorting every kind of seed crop. There are endless inventions for feeding cattle and manufacturing meat. Our modern demands for meat cannot be satisfied by mere grass and hay, or roots, or corn, or lentils, in their natural state—they are sliced, pulped, and steamed in half a dozen different ways. Machinery splits beans, crushes oats, grinds corn, and in every possible manner is designed to save the time, the teeth and the digestion of meat-making animals. Elaborate inventions are now utilized in most agricultural districts, which, figuratively speaking, take in sheaves of corn at one end, and deliver it as grain in sacks, cleaned, weighed, and ready for market at the other. Half a century ago, before railroads opened up cheap conveyance, and trained skilled mechanics had developed the tools for making machinery, with rare exceptions the agricultural implements were made either on the farm or at the nearest blacksmith's shop. Now, and in fact since 1843, when a thrashing machine was a great curiosity, the application of steam to the varied uses of the farmer and cultivator of the land is, and has been, little short of marvellous.

In the last five-and-twenty years the progress of mechanical science has been specially rapid. True, we had about 1860, besides the ocean steamships, including the *Great Eastern*, still the giant of the tribe, a complete system of machinery for cotton and textile fabrics; the steam hammer, Armstrong's accumulator, and types of all machine tools; there had been one attempt to lay an Atlantic cable; the Suez Canal was in course of construction; if not perfected, the Bessemer process was in use; and we had monster ironclads and rifled ordnance. But the subsequent period was prolific of the telephone, the incandescent electric light, the dynamo, and the secondary battery, the gas engine, the sewing machine. The last-named invention, though little calculated to attract notice, in its influence on the welfare and appearance of all grades of society, yields in importance to few, if any, previous mechanical inventions. And yet it has not diminished the demand for labour in the making of clothes or boots. Like other machines that are called "self-acting," it requires a directing mind to turn it to the best advantage for its owner. A self-acting mule may be worked by a young person at a few shillings a week; but it is found better worth while to place it under the superintendence of a more experienced workman and to pay him double the wages. It is just as true in machine labour as in handicraft, that the high-priced English workman is, so to speak, a cheaper article than the low-priced labourer of other countries. Not many years ago an Austrian cotton manufacturer declared that with the newest and best English machinery thirteen hours a day of labour from the Austrian hands does not produce more than would be turned off by the same number of men in Lancashire in little more than half a dozen hours. Manufacturers in other Continental countries bear similar witness. In the Crimea it was found that it would be cheaper to take out highly-paid English labourers than employ Croats living on the spot at sixpence a day. At the celebrated Brussels Conference the evidence was overwhelming that, notwithstanding the high wages of English artisans, labour was as cheap in England as in any other country.

Every advance in the use of machinery therefore creates well-paid service, and increases the number of comparatively affluent working men. "I cannot," said a successful manufacturer, "afford to work my machine with a horse that costs less than thirty pounds, or eats less than eighteen pounds of oats a day." As it is with horses, so it is with men. With every development of machinery comes a demand for better labour, and the offering of better pay. With it comes also increase of production, and a necessary widening of the whole field of labour and of the resources of the working class—a cheapening of the product, and consequently a more extended, a more certain, and less fitful demand, a lessening of that fluctuation in the labour market which makes the well-being of the workman insecure.

Great, then, proves to have been the mistake of the poor fellows who half a century ago dragged out machines and burnt them in the market places, and in the streets of provincial towns!

CHAPTER XI.

INDUSTRIAL DANGERS AND PREVENTIVE APPLIANCES.

THE extraordinary developments of the multitudinous industries of modern times have necessitated, under all governments, and upon frequent occasions, special interference for the protection of the artisan from the manifold and peculiar dangers that surround the practical carrying on of any branch of trade or manufacture. Unfortunately, employers of labour have not always been as solicitous as they might have been for the safety of their employés, and to this circumstance must be attributed the fact that the State has been so often compelled to interfere by numerous preventive legislative enactments, reaching the climax in the consolidated Act of 1878, with which the name of Viscount Cross will ever be nobly associated. We are indebted to a foreigner, Ernest Elder Von Plener, the First Secretary to the Imperial and Royal Austro-Hungarian Embassy in London, for the first History of English Factory Legislation. The work appeared nearly fifteen years ago—at a time when more than ordinary value was attached to it, on account, as the Right Hon. A. J. Mundella wrote, of the fact that in almost all countries where manufacturing was practised on an extensive scale, and where the social and educational condition of the people was an object of public solicitude, steps were being taken to adopt and extend the principles adopted here.

It was owing to the fact that the great development of our industries towards the end of the eighteenth century was unaccompanied by any State regulation or supervision which led to gross universal neglect of the commonest precautions for the preservation of the health and lives of the workers, that the Health and Morals Act was passed in 1802. This measure was known as the elder Sir Robert Peel's Act, and it originated out of the practice of apprenticeship adopted by poor-law overseers in regard to children whom they despatched from their care to the rising hives of industry in the north. Like Oliver Twist, the workhouse children were despised and uncared for by the poor-law officials, who were ever ready to transfer them from their care to what was then the white slavery of the manufacturing districts. The little ones were worked day and night, and there are on record instances of cases where one gang of apprentice-children, when exhausted, went to rest in the beds still warm of those who were coming on to work. Epidemics were the consequence of such overcrowding, and this and other circumstances conduced to the passing of the Act. It was singularly simple in construction. It began by requiring factories to be well whitewashed twice a year, and a sufficient number of windows to be provided to supply fresh air. Every master was required, by one clause, to furnish each of his apprentices with one new suit of clothes yearly; and the apprentices were to be instructed in reading, writing and arithmetic. The hours of working were limited to twelve daily, night work was prohibited, with certain exceptions, and apartments for males and females were to be kept distinct. Not more than two were to sleep in one bed; the rooms were to be washed with quick-lime and water twice every year, and the observance of the Sabbath Day was insisted upon in the measure, which may be regarded as the beginning of all Factory Legislation. The apprentices were to be instructed in the principles of the Christian religion for one hour a day at least on every Sunday, by some duly appointed person, and before any apprentice had attained his eighteenth year he was *to be carried* to the Parish Church to receive the Sacrament of the Lord's Supper. The point of interest about this Act, which, strangely enough, remains to this day unrepealed, is the fact that it applied directly only to legal apprentices, who being, as Professor Stanley Jevons called them, "industrial slaves," indubitably needed the protection of the law.

This first effort by no means eradicated the evils it sought to remedy. The large increase of factories created additional evils, and Parliament soon became cognizant of the fact that great numbers of children were being overworked, and injured physically, mentally, and morally, because they did not enjoy the protection designed by the Act of George III. cap. 73. A Parliamentary inquiry was rendered imperative, as it was shown that hosts of juveniles residing near factories were working in them without becoming apprentices, and consequently had none of the advantages secured to the legally bound. Parents were almost as grasping and careless of the children's health as the masters, and evidence under this head before a Select Committee of the House of Commons in 1816, led to the passing three years later of the second Factory Act—59 George III. cap. 66. Cotton mills, however, were the only factories comprehended in this measure, which provided that the age at which children could be admitted to such mills should be limited to nine years of age and upwards. Between the ages of nine and sixteen children were not allowed to work more than twelve hours a day, exclusive of meal-times, and night work was again prohibited. In 1825 further restrictions were imposed upon labour by the act of Sir John Cam Hobhouse. Children under sixteen were especially protected, and a half, or rather a quarter holiday was provided on Saturdays. The work on that day was not to exceed nine hours in length, to be completed between five in the morning and half-past four in the afternoon. Meal hours were carefully provided, and labour of any kind during such hours was absolutely prohibited. For the first time a register of children was now required, and the signature of the parents or guardians of a child to the statement of age was to exempt employers from penalty in case of falsity. Powers were given to magistrates; but no justice interested in cotton mills was allowed to adjudicate under the Act.

Troublesome times followed the last-mentioned Bill. The political crisis of which the Reform Bill was the ultimate result occurred; trades unions, too, were active; and then began that strong agitation for the amelioration of the condition of the factory worker, which brought forth the energetic and sympathetic advocacy of such men as John Fielden, Nathaniel Gould, and Richard Oastler, the Factory King, as he was subsequently called. The key-note of the agitation was struck by Oastler in his memorable letter to the *Leeds Mercury*, of the 29th of September, 1830—a letter which went through the land like a mighty cry of anguish, and stirred the hearts of men to the deepest indignation. "Let truth speak out," he wrote, "appalling as the statement may appear. The fact is true, thousands of our fellow-creatures and fellow-subjects, both male and female, the miserable inhabitants of a

Yorkshire town, are this very moment existing in a state of slavery more horrid than are the victims of that hellish system, *colonial slavery*. These innocent creatures drawl out, unpitied, their short but miserable existence in a place famed for its profession of religious zeal, whose inhabitants are ever foremost in *professing* 'temperance' and 'reformation,' and are striving to outrun their neighbours in missionary exertions, and would fain send the Bible to the farthest corner of the globe; ay, in the very place where the anti-slavery fever rages most furiously, her *apparent charity* is not more admired on earth than her *real cruelty* is abhorred in heaven. The very streets which receive the droppings of an 'Anti-Slavery Society' are every morning wet by the tears of innocent victims at the accursed shrine of avarice, who are *compelled*, not by the cart-whip of the negro slave-driver, but by the dread of the equally appalling thong or strap of the overlooker, to hasten, half-dressed, *but not half fed*, to those magazines of British infantile slavery—*the worsted mills in the town and neighbourhood of Bradford!* Thousands of little children, both male and female, *but principally female*, from seven to fourteen years of age, are daily *compelled to labour* from six o'clock in the morning to seven in the evening, with only—Britons, blush while you read it!—*with only thirty minutes allowed for eating and recreation*. Poor infants! ye are indeed sacrificed at the shrine of avarice, *without even the solace of the negro slave;* ye are no more than he is *free agents;* ye are compelled to work as long as the *necessity* of your needy parents may require, or the cold-blooded avarice of your worse than barbarian masters *may demand!*" Much more in the same strain followed.

Richard Oastler succeeded in mingling the factory question with the more purely political controversy of Reform in a manner which led to the general clamour for the restriction of non-adult labour in factories. The Conservatives and county party supported the Ten Hours' Movement, whilst manufacturers for the most part keenly supported the Reform Bill. Recent legislation had not affected the wool industries, and the sufferings of overworked children appealed powerfully to the public. The result, after much debate, was the passing of Lord Althorpe's Act in 1833—an Act which was the most remarkable advance in legislation of this character to that period. Its intention was the regulation of the labour of children and young persons, who were not apprentices, in the mills and factories of the United Kingdom. Mr. J. R. Lakeman, H.M. Senior Metropolitan Inspector of Factories, points out in his handbook, "Health in the Workshop," that the tightening of the law is first perceived in this Bill, inasmuch as night work was abolished for all under eighteen years of age, and those under eighteen could only be employed for twelve hours per day, whilst the employment of children under nine was prohibited, but those between the ages of eleven and thirteen were permitted to work for eight hours a day. It also forbad the employment of a child in more than one mill in any one day, a practice which it was found had defeated the whole intentions of the former Act; and so as to check the system and to regulate the employment of children according to law, which, for the want of properly appointed officers, was not done, a number of inspectors were appointed to see that the provisions of the Act were carried out, as the justices had proved but inefficient executors of previous legislation. The Act made no provision on some subjects which had been dealt with in other measures. The protection of morals, the teaching of religion, and the clothing of apprentices were ignored; in fact the more practical view of the real wants of the operatives was entertained, inasmuch as the cruelty of parents and employers arose as a mountain of iniquity to be levelled before any moral or religious law could be valued. Mr. Lakeman describes the situation at this time. Children were taken from their beds in early morning, carried asleep on their fathers' backs, put into the mill to work, and so brought home at night to be replaced on the bed until five o'clock on the following morning. The half-time system originated from these circumstances, and it was owing to the suggestion of Mr. Edwin Chadwick that all factory children henceforth were compelled to attend school, and receive something in the shape of education. Thus a system grew which was afterwards held to be the "sheet anchor of hope" in securing to the whole juvenile population of the North nothing short of the full advantage of the first righteous Act which fed and educated, and afforded proper time for relaxation and for meals to the whole of the children at work; and so that no master should frustrate the intention of the law, it was enacted that no child should be found on the premises for more than his nine hours, and parents, the chief offenders, then were liable to punishment if their children were in any way illegally employed with their knowledge, and the servants of mill occupiers were also made responsible for any illegal act done by them.

Ten years' experience, and the development of public opinion, pioneered by Richard Oastler, Lord Ashley (afterwards Lord Shaftesbury), John Fielden, and others, brought forward a more advanced measure in protection of the factory operative from the iniquities of slave-driving employers, and cruel and inconsiderate parents. Lord Ashley won by long and arduous agitation two victories over the government in the House of Commons, in favour of a ten hours' limit to the labour of women and children, and at last Sir Robert Peel agreed to accept a twelve hours' limit, and the amended Bill of Lord Ashley became law. Its provisions were that the working hours of children under thirteen should be diminished to six and a half hours a day; that the time during which they were to be under daily instruction in schools should be extended from two to two and a half hours in winter, and three hours in summer; that the labour of persons between thirteen and eighteen, and of adult women (now first brought under the Factory Act) should be limited to twelve hours a day; that a certificate of baptism should be produced, if demanded, to prove that the child was really of the age required by the law; that the amount of the fines imposed by the violation of the law should be diminished, but that they should be inflicted for each person improperly worked, instead of for each offence, which might include several persons. The Act required that notice should be given whenever a new factory was commenced; certifying surgeons were appointed to examine as to the health and physical fitness of the young before it was lawful to employ them; cleanliness, as in former Acts, was to be confined to lime-washing and painting the walls, ceilings, and passages; workers in wet flax spinning mills were to be protected from steam and hot water, through which the flax was spun; mill gearing was not to be cleaned when in motion by any child or young person; all dangerous gearing was to be securely fenced for the protection of children, young persons, and females—a provision for the first time introduced into factory legislation, and an evidence that steam and water power were being more extensively used; whilst machines were run at more dangerous and higher speed, in consequence of the progress of invention.

A remarkable omission in this Act was that it excluded men from the protective provisions, a circumstance which naturally necessitated additional legislation afterwards. Accidents had been numerous; more than a hundred deaths occurred in a brief period from preventable occurrences, and they made up the appalling aggregate of nearly twelve thousand such accidents in the history of factories and workshops. These few thousands of catastrophes, a caustic writer of the period remarked, were the results of the administrative kindness so abundant in this country. They were all the fruits of mercy. A man was limewashing the ceiling of an engine room, he was seized by a horizontal shaft and killed immediately. A boy was brushing the dust from such a ceiling, before whitewashing, he had a cloth over his head to keep the dirt from falling on him; by that cloth the engine seized and held him to administer chastisement with rods of iron. A youth, while talking, thoughtlessly took hold of a strap that hung over a shaft; his hand was wrenched off at the wrist. A man climbed to the top of his machine to put the strap on the drum; he wore a smock, which the shaft caught; both of his arms were then torn out of the shoulder joints, both legs were broken, and his head was severely bruised; in the end, of course, he died. What he suffered was all suffered in mercy. He was rent asunder, not perhaps for his own good, but as a sacrifice to the commercial prosperity of Great Britain, for these accidents arose in this way. By the Act last mentioned, it was expressly enacted that all parts of mill gearing should be securely fenced. There were no ifs and buts in the Act itself; but these were allowed to step in and limit its powers in preventing accidents out of a merciful respect, not for the blood of the operatives but for gold of the millowners. It was strongly represented that to fence those parts of the machinery that were higher than the heads of workmen—more than seven feet above the ground—would be to incur an expense wholly unnecessary. Kind-hearted interpreters of the law, therefore, agreed with millowners that seven feet of fencing should be held sufficient. The results of this imperfect legislation were the disasters already alluded to—disasters due to that good-natured determination not to carry out the full measures of protection, but to consider that quite sufficient was done if the boxing-off of machinery were made compulsory in each room to the height of seven feet from the floor. Neglect as to the rest, it was said, could lead to no accidents, or at any rate only to a few, that would really not be worth much cost of prevention. As kings do no wrong so machines never stop, and what great harm was done if A, putting on a strap to a driving pulley, was caught by the legs and whirled round at the rate of ninety revolutions a minute?—what if B, adjusting gear, had one arm and two thighs broken, an elbow dislocated, and a temple cracked?—what if C, picking some cotton from the lathe straps, became entangled, had an arm torn off, and was dashed up and down, now against the floor, and now against the ceiling?—what if D, sewing a belt, were dragged up by the neckerchief, and bruised by steam power as if he were oats?—what if the boy E, holding a belt which the master had been sewing, were suddenly snapped up by it, whirled round a hundred and twenty times in a minute, and at each revolution knocked against the railing till his bones were almost reduced to powder?—what if F, oiling a shaft, were first caught by the neckerchief, then by his clothes, have his lungs broken, his arm crushed, and his body torn?—what if G, packing yarn into a cart, and stretching out his hand from a corner of the cart, were blown across a horizontal shaft, were caught up, partly dismembered and thrown down a corpse?—what if H, caught by a strap, died of a broken backbone, and J died crushed against a beam in the ceiling, and little K, carrying waste tow from one part to another, were caught up by it and had his throat cut, and L died after one arm had been torn off and his feet crushed, and M died of a fractured skull, and N died with his left leg and right arm wrenched from their sockets, and O, not killed, had the hair of his head torn away, and P were scalped and slain, and Q beaten to death against the joist of the ceiling, and R, coming down a ladder, were caught by his wrapper and bruised, broken and torn till he were dead? and what if all the rest of the alphabet were killed, and destroyed in ways as horrible? Every case here instanced, and many others, happened between the brief period that elapsed from the passing of Lord Ashley's Bill to the enactment of the great Ten Hours' Bill in 1847.

In the interval, when it became evident that, in addition to a large list of most serious accidents, there were so many lives sacrificed annually to save millowners a little trouble and expense, a circular was issued by the factory inspectors, expressing their determination to enforce the whole Factory Act to the utmost, and so to compel every shaft of machinery, at whatever cost, and of whatever kind, to be fenced off. A deputation of manufacturers waited upon the Government, and the Home Office was induced to make some concession. For instance, manufacturers were absolved from the necessity of absolutely boxing up all their machines, and they were required only to use the precautions that occurred to them for the prevention of accidents. Machinery was allowed to be adjusted only when the shafts were not in motion; ceilings whitewashed only when all the machinery was standing still; and men working near shafts had to wear tight-fitting dresses, &c.

The extension of the Factory Acts to hitherto unprotected industries had occupied the attention of philanthropists for some time, and the Ten Hours' Bill comprehended persons employed in all processes incident to the manufacture of cotton, wool, hair, silk, flax, jute, hemp, or tow, separately or mixed together, or mixed with any other material, or any fabric made thereof, with the exception of factories used solely for the manufacture of lace, hats, or paper, or solely for bleaching, dyeing, printing, or calendering. The legal working day was now limited to between six in the morning, and six in the evening, with an hour and a half for meals, having a maximum of ten and a half hours for work. Any person simply found on the premises of a factory was to be deemed at work. A Saturday half holiday after two o'clock was securely provided for, and the general construction of the Act showed plainly that it had been conceived in a spirit to make evasion impossible, and to afford real and undoubted protection to the millions of men, women and children employed in the manufacturing industries of this country. This Bill, moreover, was the basis of those subsequent measures which have done so much to lighten the lot of the toiler, and promote his welfare and the happiness and education of his offspring.

A further advance in Factory legislation was made in 1867. In this year a couple of measures (the Factory Act Extension Act, and the Workshops Regulation Act) brought almost all establishments to be called manufactories under supervision. The number of sub-inspectors was increased, and a distinction in method of enforcing the two Acts afforded a profitable comparison between the merits of localized and centralized management. The Workshops Act was to be enforced by local authorities; but, as many town councils decided not to interfere with trade, whilst others silently ignored the Act, it was obviously a failure in numerous instances. Further legislation remedied this in 1871, by transferring the working of the Act from the local to the central authority. The Factories (Health of Women) Act followed in 1874, and in 1878 was passed the measure spoken of at the opening of the chapter. The changes effected by the latter were not great; its chief purpose was to make the law clear, consistent, and concise. Nevertheless, Professor Jevons had a difficulty in summarizing its provisions, which are contained in four principal parts and six schedules. The first part contains the general law relating to factories and workshops, treating, in a succession of sanitary provisions, the safety of employés, their employment and meal hours, holidays, the education of children, certificates of fitness, and notice and investigation of accidents. The second part is in greater detail, and provides specially for particular classes of factories and workshops as regards health and general safety and protection. It includes special restrictions of employment, special exceptions regarding Jews, meal hours, overtime, night work, domestic employment, &c.

The machinery of administration is provided by the third part of the Act, such as the appointment of inspectors, certifying surgeons, the regulation of clocks, the provision of registers, enforcement of penalties, and legal procedure. Part IV. settles the difficult question of definition of terms, the mode of application of the Act to Scotland and Ireland, and specifies some minor exceptions. It also finally repeals sixteen previous Factory Acts and a few sections of other Acts. The schedules of the Bill give in detail the occupations which are subject to certain special restrictions or exceptions. "Such, however," says Professor Jevons, "are the complications of this remarkable code of law—the mere table of contents filling eight pages and the text sixty-five—that anything approaching to a commentary upon its effects would fill a large volume." It must suffice to say that the general assumption of the Act is that labour in textile factories involves a more severe strain than that in non-textile factories and workshops, while the longest period for which a young person or woman may be employed in textile labour without an interval for meals is four and a half hours, the corresponding limit for other labour is five hours. Textile factories are defined in one section as premises in which steam, water, or other mechanical power is used in manufacturing cotton, wool, hair, silk, flax, &c., not including bleach, print, and various other kinds of works. The description of non-textile factories occupies a long schedule, and workshops are practically any place not being factories where manufacture is carried on. The hours of work seem to be in no case absolutely fixed, but on five days a week are either to begin not before six o'clock in the morning and end not later than six at night (in workshops not later than nine o'clock at night), or else not begin before seven in the morning and finish not later than seven o'clock P.M. Work must end on Saturdays in textile factories at or before two o'clock, and in other factories and workshops at or before four o'clock. The meal-times shall amount to not less than two hours a day in the textile factories, and one hour and a half in other places of work, except on Saturday, when half an hour only may be allowed. The general result is a working week of fifty-six and a half hours in textile factories, and sixty in non-textile factories and workshops, subject to holiday and other exceptions. The employment of children in any factory or workshop is absolutely prohibited under the age of ten years—a rule, by the way, extended to industry generally by the late Mr. Forster's Education Act. Under sixteen years of age a certificate of fitness for factory labour is imperative, and children are only to be worked on the half-time system. Sunday labour is prohibited on the part of all children, young persons, and women, excepting Jews, for whom special regulations are laid down. Particular trades, moreover, have innumerable exceptions and relaxations, as in the case of manual labour being carried on at home at irregular intervals; the work of straw-plaiting, pillow lace-making, and glove-making, when carried on in a private house. And the Secretary of State is empowered to extend such exemption to other light, healthy handicrafts. The terms employed in the Act do not include male persons above the age of eighteen, except in sections relating to safety and sanitary precautions, so that it follows that men are allowed to work, as they like, day or night. Further exceptions allow overtime up to nine or ten o'clock at night, when fruit has to be suddenly preserved, or railway guides bound at the end of the month, or Christmas presents rapidly pushed forward, or some similar press of work undertaken. When water mills are liable to be stopped by drought or flood, a certain amount of overtime may be granted by the Secretary of State to make up the loss.

The Secretary of State has exercised his power frequently under several sections to afford additional relaxations under such circumstances as printing offices engaged in printing newspapers or other urgent publications on Saturday; or workshops in which clothes are made. Hosiery and woollen factories have also received special official attention.

The piecemeal method of factory legislation which ultimately led up to the Act here summarized had been adopted in regard to a variety of trades and occupations, in all of which there was more or less danger. Special trades were singled out for special legislation, and in this way many of the working classes were protected while others were neglected. To get an idea of the dangers to which numberless artisans were exposed, we may refer again to Mr. Lakeman's contributions to the literature of the Health Exhibition. In his chapter on "Sanitation," he traces the history of its improvement in regard to factories and workshops. The first real sanitary clause was introduced into the Bill of 1864, which requires cleanliness in every factory and workshop. Now, this enactment applies to every factory and workshop in the kingdom—at first it referred only to half a dozen trades. Government inspectors are entrusted with the removal of violations of the law in this particular, and it is satisfactory to know that much success has attended their efforts. In times not long gone by, the textile factories were by no means the well-appointed places of to-day. Machinery had reached no degree of development, labour was irregular, and all the conditions of factory life were foreign to the conditions that now exist. Steam factories, however, appeared upon the scene, and consideration for the workers continued to be lost sight of in the march of commercial progress. Continual labour by day and night in the hot and ill-ventilated places of business seemed to create a distinct race, so far as physique and condition were concerned. High temperatures, want of ventilation, no escape for dust or atomic fibrous matter, no proper closet arrangements, were the chief ills existing; there was no loftiness in the rooms, and in the carding and blowing departments there was a lack of any appliances for carrying off dust and impurities. Poisonous gas from cesspools created diseases which the operatives took to their homes, and altogether the race was in a fair way towards a rapid decline. The picture Mr. Lakeman gives of "then" and "now" in the manufacturing centres is instructive and gratifying. In the cotton mill to-day we find self-acting machinery, the carding machine covered in, the willowing machine also covered in, fans used for blowing off the dust which the willowing scatters over the floor and throughout the room. Progression has equally marked the extension of the worsted and woollen industries. The old wretched places of half a century ago have disappeared, magnificent structures have been reared, machinery of the most approved pattern has been set up, the temperature is normal, and the sanitation good. In flax mills the improvement has not been so great, for under no system of ventilation can a perfect withdrawal of fibre and dust be effected. The process of "heckling" is very dusty and injurious; workers cannot avoid swallowing impurities, and during first employment in this department vomiting and nausea supervene. Machinery in the drawing and roving process being sometimes laid in one room, the working together of a large number of people, mostly young, is necessitated, to the detriment of health. The preparation of tow, which is the short coarse fibre produced from flax during its cleansing, is a dangerous occupation, and although women engaged in it have been advised to wear respirators provided for their use, yet they prefer to work without them. In the wet spinning process there is danger to the health of workers, which, as already pointed out, was realized by the Factory Act of 1884, which laid down special sanitary precautions with regard to the children and young persons employed in it. Chest complaints, and a peculiar "flax fever" are the dangers of this branch of industry, and ten years ago three-fifths of those who died in this trade were carried off by diseases of the respiratory organs. The average life of a carder then, according to the statistics to which we refer, and which are those of a factory-certifying surgeon, was 45·7 years, with a period of employment of 16·8 years; that of a preparer 28·7 years; of dressers 16·6 years of employment. In the manufacture of jute—the process being practically the same as those of flax—there is, however, a sanitary safeguard. The jute is saturated with oil to render the fibre flexible, and thus the danger is modified. More recent improvements in machinery, and the energies of owners of extensive works directed to the preservation of the health of their workers have, however, achieved the desirable consummation of ridding both wet and dry flax spinning concerns of most of the very serious evils which once characterized them; and have furnished the conclusive evidence upon which Her Majesty's inspectors dwell with satisfaction, that in our textile factories great improvements have been made in the essentials to comfort in employment, and in the promotion of the means whereby health may be secured—" the crooked leg or the distorted spine as the result of factory labour has disappeared for ever, the period of pale and haggard faces of children has given way to one of ruddy and joyful countenances. The mirthful spirit on dismissal from school is absorbed in play, and happiness now largely enters into the existence of a factory half-timer."

Pottery manufacture was one branch of industry in which the danger to health was seriously great. The high rate of mortality in Staffordshire was simply appalling, and the reports spoke of dull and cadaverous countenances, paralysis, consumption, and a host of nervous diseases originating in or aggravated by the processes of scouring and ground-laying, in the sifting rooms, and in the hot houses, which were rooms within rooms closely confined, and in every respect most unhealthy. Succeeding generations of potters were reported to become more dwarfed and less robust; they represented a degenerated population, physically and morally, and continued to develop the degeneracy by employment under conditions foreign to any law of health. When the factory inspector came upon the scene in 1864 he found in the potteries an immense field for the exercise of his powers. The consequences of the greater restriction imposed by him were gradual improvements in the places of work, and in the physical tone of the operative. Within three years it was reported that "a marked feature in the trade history of the year was the erection of new and improved manufactories, and an extended introduction of machinery, more particularly in the clay-making department, together with the means of preventing the inhalation of dust, thereby lightening labour and adding to the physical improvement of both young and old."

The manufacture of lucifer matches was fraught with extreme danger under the old system. The labour was chiefly that of children, young persons and women, with a few men, and the manufacture originated out of the discovery, in the year 1833, of a way of applying phosphorus to the match itself. In consequence of the absence of any general knowledge of the nature of the employment and its effect upon the health of those engaged in it there was not much attention aroused, until years afterwards medical science was attracted to it by a Vienna surgeon who had traced to this occupation that painful and loathsome disease—necrosis of the jaw. Dr. Letheby delivered a lecture at the London Hospital on the subject, and legislation at length stepped in. By its combination with modern discoveries and appliances, the industry, which has risen to vast proportions, has been transformed from one of a deadly tendency to a harmless occupation. The lucifer match maker no longer complains of aches and pains, nor are his jaws diseased.

In the innumerable divisions of labour comprised in the metal trades there were originally all the unhealthy surroundings that it was possible could characterize any business, and the victims were largely females and young people. The processes of chain and bolt making, japanning and finishing, screwbolt forging, block and key making, gun making, the rolling of iron, and all the kindred trades, involve excessive labour, and the regulations under which they have been placed have not effected any great change in the condition of the employed. The night employment of children has been stopped; overtime in domestic workshops by children has been discontinued; tool grinders have been provided with fans, so that dust, grit and metal particles are carried off; the ventilation in button and pen works, and burnishing, has been effectually dealt with, and overcrowding reduced. In those occupations which are classed as being injurious to health, care is now taken, and has been for years, to bring before manufacturers the defects or evils which are found to be hindrances to the health of workers and to suggest remedies. While lead works, type-founding, chemical manure works, vitriol manufacture, drug grinding, tin-plate works, glass, silvering of mirrors by the old mercurial process, cardboard enamelling, paper colouring, bronzing, and employment in salt mines, are enumerated as occupations dangerous to health by reason of the processes carried on, those that are not so injurious on that account, but are rendered unhealthy for want of space and ventilation, are stated to be, letterpress printing offices, bookbinding, tobacco and cigar making, envelope making, and many industries such as the making of ostrich feathers, artificial flowers, fancy boxes, frilling and goffering, boot and shoe making, millinery costume making, fur sewing for caps, and stitching of waste dyed fur skins, and tailoring.

Before leaving the sanitary aspect of Industrial Dangers brief allusion should be made to one of the chief causes for the Factory Act of 1883. The measure referred to legislated especially for white lead works and bakehouses. The danger to health, however, was obviously much greater on account of the insanitary condition of the latter than the absence of adequate restrictions upon the former. In 1881 a report on the condition of the London bakehouses made a deep impression. The finding of dirt, filth, open sinks and closets, the roosting of fowls over a trough, the keeping of rabbits in bakehouses, the overrunning of cesspools into them, so horrified people that legislation was demanded, with the result that it was enacted (1) That no water-closet, earth-closet, privy, or ash-pit, shall be within or communicate directly with bakehouses; (2) Any cistern for supplying water to the bakehouse shall be separate and distinct from any cistern supplying water to a water-closet; (3) No drain or pipe for carrying off fæcal or sewage matter shall have an opening within the bakehouse. And the medical officers of health have power of entry and inspection and of taking legal proceedings.

Manufacturers, who were animated at first, as we have seen, by considerations for their own material gain, to the total disregard of the safety of their work-people, have in recent years, partly through Parliamentary compulsion, and partly on account of the development of more cordial relations between employers and employed, been more solicitous in adopting measures for the preservation of the lives and limbs of their operatives. Factory workers, too, in addition to the protection afforded them by the Factory Act of 1878, have been enabled, by the Employers' Liability Act, to recover substantial damages for personal injury in case of an employer's neglect of ordinary precautions for the protection of his workpeople.

Accidents in this connection may be divided into three classes—those which happen by contact with mill-gearing when in motion; those which are the result of contact with machinery other than gearing, and to which operatives are exposed; and those that occur through carelessness, or from some fault of the worker. As far as law can effect a decrease in the number of accidents by establishing checks, and enforcing conformity to regulations, it has done so, and Her Majesty's Inspectors have always evinced the greatest anxiety to diminish the fatalities, and minor casualties which may come under the category of "preventable" occurrences. It has been a task of considerable difficulty to devise safeguards in the numerous industries carried on under all sorts of conditions, and rapidly undergoing change. One difficulty is that men become so familiar with ever present danger that they never fear it. Women have been mutilated by inattention to the matter of appropriate costume for the factory, while men have sacrificed themselves in large numbers to the insensate folly of cleaning moving machinery. Children have been killed owing to unfenced machinery, upon which subject the report of the Children's Employment Commission (1862) is painfully interesting. The relative proportion of accidents was pointed out some time ago to have been largest in flax factories; a circumstance accounted for from there being a greater proportion of females, young persons, and children—"the least heedful class of operatives"—employed in them than in either the cotton, woollen, worsted, or silk industries. A large number of the accidents reported annually to the inspectors are the result of the victims actually playing with machinery in motion, and wantonly placing in jeopardy their lives and limbs in mere bravado.

Since the passing of the Employers' Liability Act there has been a sensible diminution in the number of preventable accidents, although there will always continue to be met with in the returns records of reckless operatives who have suffered injury by ignoring the safeguards adopted in their interests. An association of textile manufacturers, after the passing of the Act in question, issued a code of instruction which is now largely observed, particularly in the North. These instructions run thus:—"For the safety of persons employed in these works the following bye-laws must be strictly observed—(1) A workman shall not use a machine or plant in which he knows there is a defect, if such use is likely to occasion personal injury. (2) No person shall attempt to clean machinery when in motion. (3) Safety guards shall be properly fixed on every machine before it is set in motion, and such guards shall not be removed whilst it is at work. (4) Driving straps shall not be put on or taken off by any one except the person specially appointed for that purpose. (5) Boys or other young persons shall in no case be allowed to oil machinery, and no machine shall be oiled when working if there is danger in so doing. (6) Hoists shall not be worked by any one but those employed for that purpose. (7) A workman shall see that any notice or information required by the Employers' Liability Act to be given to him is entered in a book kept for that purpose."

In these days the precautionary measures adopted are perhaps as general and efficient as could well have been hoped for. Employers of labour, as a rule, realize the paramount duty of protecting those in their service, and it would be but a small return for this care on the master's part for the workpeople to avoid as far as possible contributing by heedlessness or recklessness to swell the list of casualties annually compiled in the department of the Home Office.

CHAPTER XII.

THE PERILS OF THE MINE.

NOT even those who go down to the sea in ships, nor the brave fellows who with such conspicuous heroism fight the Fire-fiend on land, nor yet the myriads who toil in the colossal factories of the world and run dangerous risks among machinery, encounter greater and more serious dangers than the army of men who daily descend to the bowels of the earth to gather the "black diamonds," and the mineral wealth which have so conduced to the prosperity of England.

Mining in England is the excavation and the winning of geological deposits by subterranean labour, and we are enabled annually by the system of supervision adopted by Government to arrive at interesting statistics under this head. The general public know little of the extent of underground operations, and are apt to look upon the hosts of workers upon the world's surface as the maximum of its inhabitants. But the last official summary supplied to the Home Office shows that during the year 1886 the aggregate number of persons employed in and about the whole of the mines in the United Kingdom of Great Britain and Ireland amounted to considerably more than half a million. The great majority are occupied in coal mines, although in these islands iron as well as coal is one of the leading products of the earth. The proportion of coal and iron to the total of the mineral output in the same period was ninety-four per cent. In the balance there was included, of gold ore, one and a half hundredweight, and under six tons of silver.

There are in the United Kingdom some twenty principal coal districts, which have been divided as to their characteristics into three descriptions :—The first, those forming complete basins, such as the South Wales region ; the second, those having only one arm of the basin visible, as in the North of England ; and the third, those of irregular formation, such as are found in South Staffordshire or the Black Country. From these districts half the coal production of the world is won, and it is in this winning that life is daily jeopardized, and often sacrificed to an appalling degree.

Since the general adoption of coal as a fuel in London in 1400 (although it was not in common use in England until two hundred years later) coal-mining has been an operation of considerable risk. In the first instance rude inventions were the only instruments to minimize the danger, whilst later, scientific development and legislative interference have combined to reduce as much as possible underground risks.

As light was the first essential in working the subterranean coal-beds, the story of the safety lamp has the most romantic interest in any history of underground dangers. And, singularly enough, the lamps most approved to-day are practically the same in outward appearance as the first that were invented. That subsequent inventions have not annihilated their predecessors, so far as efficiency is concerned, is sufficiently evident from the fact that in the Coal Mines, &c. Regulation Bill introduced into Parliament in 1887, and the object of which is the consolidation and amendment of previous measures, contains the explicit assertion that "It has not been considered advisable to throw on the Government the responsibility of prescribing or authorizing any particular kind of lamp." The clause further states on the subject that it has been shown by numerous experiments that lamps formerly reputed to be safe are not safe when meeting gaseous air in rapid currents such as are generated by the modern system of improved ventilation. Here, then, is still scope for the illimitable development of the inventor's genius.

Sir Humphry Davy may be credited with the introduction of the first safety lamp that was generally, or rather extensively, employed, although Dr. Clanny of Sunderland, and George Stephenson, were contemporaries in the designing of some contrivance for safely lighting coal mines infested with fire-damp. While Davy was making chemical examination of various specimens of that gaseous product, Stephenson was engine-wright at the Killingworth colliery, near Newcastle, and was bothering his practical head about devising some kind of lamp which would not prove dangerous. Terrible explosions which had taken place had spurred the ingenuity of "Geordy," and in the month of August, 1815, he made a sketch, which culminated in the production of a lamp in the following October. This, however, was twice improved by Stephenson, and at the end of November what was at once called familiarly by the miners at Killingworth the "Geordy" lamp came into use there. During the time that Stephenson was arriving at his consummation, Sir Humphry Davy was pursuing a more orthodox scientific course. Having found that carburetted hydrogen required an admixture of a large quantity of atmospheric air to render it explosive, he proceeded with his experiments and ascertained that explosions of inflammable gases are incapable of being passed through long narrow metallic tubes. This principle of security was obtained by diminishing their length and diameter at the same time, and likewise by diminishing their length and increasing their number, so that a great number of small apertures would not pass explosion when their depth was equal to their diameter. Sieves and wire gauze were brought into the experiments, and the scientific inventor found that if a piece of wire gauze was held over the flame of a lamp, or of coal gas, it prevented the flame from passing; he found also that a flame confined in a cylinder of wire gauze did not explode even a mixture of oxygen and hydrogen, but that the gases burnt in it with great vivacity. The operation of the wire gauze in preventing the communication of flame is thus explained. Flame is gaseous matter so intensely heated as to be luminous. When the flame comes in contact with wire gauze it loses so much heat, in consequence of the conducting power of the metal, that it is cooled down below the point at which gaseous matter can remain luminous, and consequently the flame of the gaseous matter burning within the lamp is incapable of passing through it so as to set fire to and explode the mixture of fire-damp. This cooling power is exerted even through the wire gauze.

Such then was the origin of the safety lamp, the merits and defects of which, however, formed a subject for many committees of inquiry. During the Session of Parliament of 1835 a Committee was appointed to inquire into the Accidents in Mines, and before this tribunal the efficiency of the lamp was both maintained and impugned. In 1839, too, a great explosion near Sunderland re-opened the subject. A South Shields Committee was formed, and the members devoted three years to the collecting of evidence relating to the causes of colliery explosions. One of the results at which they arrived was, that the safety lamp might in some circumstances be a source of danger rather than security, if it induced a neglect of measures for ventilating mines. The management of the ventilating branch of colliery work is of course one of the most important matters. It involves the supply of fresh air to the men working in the pit, as well as the removal of the inflammable gases; but subsequent committees to those alluded to came to the conclusion that any safety lamp "would render useful service, provided care be taken in the using." The locking of safety lamps so as to render them incapable of being opened by the miners when at work is one point which has given play to a large amount of ingenuity; but all the devices have the defect of only being efficacious when the miners are not provided with matches or other means of obtaining a light. A great proportion of the accidents—probably the whole number caused by explosions—may be considered to be preventable; and that this is a fact may be fairly assumed from the circumstance of the death-rate in different mines varying considerably according to the precaution taken in each. This, at all events, was the opinion of Mr. H. W. Porter, B.A., in his observations some years ago on the Reports of the Registrar-General.

Many kinds of lamps have been devised since the trio alluded to. The Smith lamp was a modification of the Stephenson, and admitted the air through the wire gauze, as well as through the perforations in the metal plate, and other arrangements were adopted for preventing the stoppage of the perforation by dust and oil, an evil which was a characteristic of the predecessor. The Upton and Roberts lamp, the Martin, the Ayre, the Muessler, the Lemielle, and the Whitehead, were all developments of what was until a year or two ago considered absolutely indispensable to the miner. How far the electric lighting of mines may go in reducing the necessity of safety lamps, or of the large numbers in use, remains to be seen. Practical men continued to engage in controversy and experiment on the subject, and a year has not passed down to the present time during which one or more inventions have not been put forward. Elsian's, a Belgian lamp, was among the earlier ones, and its recommendation was the emission of more light than was usually obtained; Fyfe's was something like Clanny's, but had a double gauze at the top instead of single; Watson's combined an apparatus to lock it in such a way that a miner could not open it until it needed trimming; Henderson's had a double glass cylinder, having water between to cool the outer glass; Botys' was a Belgian lamp with gauze and glass; whilst Martyn Roberts's had a contrivance for extinguishing the flame if the lamp should be broken. Mr. Goldsworthy Gurney discovered that by using dull iron wire in the construction of the lamp much of the light was lost; therefore lamps were immediately brought out with the wire gauze electro-silvered.

The diversity of opinion continued in the production of further modifications. In 1867 Higgs's adaptation of the Davy appeared, and in 1871 the Plimsoll lamp was introduced. The latter has at its base an air chamber, shaped like a truncated cone, the upper rim of which closely surrounds the wick; the bulk of the cone is occupied by an iron reservoir, which leaves a space of only one-eighth of an inch between it and the inner wall of the cone; air is admitted to this chamber through minute orifices in a metal plate and passes through the narrow space to the wick; there is no wire gauze to dim the light, the flame being surrounded merely by a cylinder of thick glass. The object of this arrangement is so to limit the admission of fire-damp that the quantity entering shall be too small to break the glass by explosion; flame cannot communicate to the exterior because it would be cooled down by the metal walls of the narrow air chamber; while an explosion inside would at once extinguish the flame and prevent the lamp from becoming red hot. If the air in the mine is in a dangerous state, communication with the interior of the lamp is cut off, pure air from a separate chamber is admitted, and the flame necessarily goes out when this is exhausted.

Dr. Irvine, of Glasgow, invented in 1872 what has been described as a "Singing lamp." He pointed out that when an explosive mixture of air and fire-damp is ignited under a wire gauze surface, and a tube or a chimney is placed over the flame, a musical sound is heard, the pitch of which varies with the size of the flame and of the chimney. Two forms of lamp, one for viewers and one for miners, were constructed, the lamp giving audible warning that the air in the mine has become dangerous.

In succeeding inventions the main endeavour has been to frustrate the carelessness, and almost criminal thoughtlessness, of miners, who open the wire-gauze door of a lamp for the purpose of obtaining more light, or even of lighting their pipes. One of the most favourite devices is a combination of the wick-holder with the locking-bolt, so that the latter cannot be withdrawn without lowering the wick and extinguishing the flame. Another method consists in the use of a lead rivet, uniting the two parts of the lamp, impressed with a seal which cannot be removed without defacing the device. A more perfect method, however, is that adopted by Bidder, where the locking-bolt is magnetized, and held in place by a force which can only be overcome by the application of heavy and powerful steel magnets, which are kept in the lamp cabin at the pit bottom, from which the lamps are served out lighted to the miners at the commencement of the shift, and are collected before they return to the surface.

Of the more recent safety lamps deserving of mention are Col. Shakespeare's (light extinguished by opening), which was exhibited at the Royal Institution in May, 1879; Messrs. Fleuss & Foster's, approved in January, 1884; and that of Mr. Patterson, of Victoria House, Low Fell, Gateshead, brought out since Midsummer, 1887. The special features of Mr. Patterson's lamp are that it is light, very simple, has few working parts, gives a good light, and will automatically close or shut off the admissions of all air and gas as soon as it is placed in an explosive mixture.

Earlier in this chapter we spoke of the progress in regard to the application of electricity to coal mines, and the probable supercession of the conventional lamp by one illuminated by the electric light. The idea is not a new one; it was broached by a Frenchman five-and-twenty years ago. M. Benoit devised an electric lamp, where the light was obtained from the discharge in a Geissler vacuum tube. The lamp consisted of a box containing a galvanic battery, comprising two Bunsen cells, and a small induction coil with connecting wires which conveyed the current to the lamp. The Bunsen cells might be conveniently replaced by a single bottle-shaped bichromate battery. The invention was exhibited in Paris on the 8th September, 1862; but its cost and complication necessarily limited its use. Mr. J. W. Swan, however, the English electrician, has recently developed the idea, and has to some extent overcome the complications and expensiveness of the Frenchman's lamp. Mr. Swan exhibited his to the British Association at their last meeting at Birmingham, and it consists of a small Swan incandescent lamp, together with a secondary battery to supply the electricity enclosed in a suitable box. The lamp serves to indicate also the presence of fire-damp. An electric light fire-damp alarm is one of the latest contrivances under this head. It is the invention of Messrs. Walter Emmott and W. Ackroyd, and, like the Swan appliance, has been tested and approved.

Another source of danger to the miner is the increase of gas that may take place in consequence of the presence of coal dust; and this point has been the subject of much investigation, especially by Galloway, who found that an explosion may be produced by ignited particles of coal dust through the agency of a safety lamp, which under ordinary circumstances would be perfectly trustworthy. At Blanzy, in France, several notable and fatal explosions have been traced to the firing of coal dust from the flame of a shot, even in cases where no fire-damp was present in the workings. A well-known mining engineer brought into notice in 1886 the successful use of watering the floors of deep mines to allay the dust, and thus prevent explosion. A slight dampness, such as prevails in shallow mines at all times, is in his words sufficient to lay the dust effectively; and the systematic watering of deep mines has been introduced in many places. The water can either be brought into the galleries by tanks or by pipes from a reservoir above ground. The water not only purifies the air, but robs it of the inflammable coal dust.

As it has been found by the scientists who have given attention to the matter, that nearly all the serious casualties have arisen when great depression of the barometer has been observed, so by no means the least important preventive appliance is ventilation. The quantity of air required for a large colliery depends upon the number of men employed, as for actual respiration it is stated that from 100 to 200 cubic feet per minute should be allowed. In fiery mines, however, a very much larger amount should be provided, in order to dilute the gas to a point of safety. Even with the best arrangements a dangerous increase in the amount of gas is not unfrequent from the sudden release of stored-up masses of coal, which, overpowering the ventilation, produce magazines of explosive material ready for ignition, when brought in contact with the flame of a lamp or the blast of a shot. The management of such places requires therefore the most constant vigilance on the part of the workmen, especially in the examination of the working places that have been standing empty during the night in which gases may have accumulated, to see that they are properly cleared before the new shift commences. Furnace and machine ventilation are systems in vogue, and it is effected by carrying through the workings a large volume of air, which is kept continually moving in the same direction, descending from the surface by one or more shafts known as intake or downcast shafts, and leaving the mine by a return or upcast shaft.

The terrible accidents at the Oaks and "Talk o' th' Hill" Collieries in 1866, may be taken as typical of the special danger under a sudden fall of the barometer. There had been a disaster of appalling severity at the first-named pit twenty years before, when out of one hundred workmen seventy perished; but the explosion on the 12th December, 1866, was unparalleled in the history of such calamities. About six o'clock in the morning the whole of the hewers, boys, and drivers, numbering about 370, went down the shaft to commence their daily labour. They continued in the workings till twenty minutes past one in the afternoon, when the banksman was alarmed by the sound of an explosion in the pit, and a tempestuous rush of air and soot up the shaft. One of the cages and the rope to which it was attached were considerably damaged by the explosion; but, in the face of those obstacles, no time was lost by the authorities in descending the pit. At the bottom of the workings immediately adjoining the shaft eighteen men, seriously injured but still living, were discovered, and at once conveyed to the surface, where they were promptly attended to. Between thirty and forty bodies had been brought up when a second explosion occurred the following morning, causing the death of a company of twenty-eight searchers, who had gallantly volunteered to enter the workings. As the second explosion not only destroyed any hope that might exist of recovering men alive from the workings, but made renewed descent almost impossible, the distracted relatives, who till then had crowded round the pit, were gently removed to places of greater safety. About five o'clock on the morning of the 14th, the signal bell was heard to ring, giving indications that some one was alive at the bottom of the shaft. Mr. Marriott, who was in attendance, and Mr. Embleton, junior, resolved once more to brave the perils of the pit, and on descending found Samuel Brown, one of the explorers of the previous day. When the cage came to the surface, the excitement was of the most intense description. Brown, though weak, was quite conscious, and able to give an account of his experiences. He had wandered about the north incline for a long distance, falling over the mangled corpses of those slain by the blast. At last he found his way to the shaft, and pulled the signal. He was of opinion there was no other living being in the pit. As explosion after explosion continued to take place, the consulting engineers resolved upon extinguishing the fire raging through the workings by filling up the shaft, an undertaking only accomplished after protracted and perilous labour. The total number who perished was put down at 340; eighty-six were recovered from the pit, eighteen of whom were alive, though six of these died soon after being brought to the surface.

While the public mind was excited by the Oaks calamity, another colliery disaster of great magnitude occurred in the Potteries at the pit known as "Talk o' th' Hill." About 200 men and boys were at work in the pit when the explosion took place at noon on the 13th of December. Shaft No. 1, leading to the workings, was much damaged; but No. 2 was in working order, and down this crowds of eager volunteers hastened to search the pit. Their efforts were attended with considerable success. Fifty in a short time were sent alive to the surface, and throughout the afternoon twos and threes were frequently brought up in the cage, to the relief of distracted households. Still the loss was considerable, and but for the overwhelming catastrophe at Barnsley would have engaged the public mind as among the most calamitous events in the annals of colliery disasters. The deaths amounted to eighty-five.

The most terrible accidents of the same kind within previous years, if not within living memory, were those at the Lundhill and Hartley Collieries. In the former, which happened in 1857, the number of victims was

189; in the latter, which happened in January, 1862, the number was 209.

The opinion now gained ground that from an examination into the circumstances of the colliery explosions of previous years it would appear that familiarity with danger induces carelessness, and the report of the Official Inquiry into the two last-named was awaited with interest. In the course of the proceedings it was stated that on the 10th of December the mercury stood at 30-40; on the 11th there was a fall of nearly one inch, and that fall continued till the 13th. After repeated adjournments the following verdicts were arrived at: In the "Talk o' th' Hill" disaster, that the deaths had resulted from "accident"; that there was no positive evidence to show how the accident occurred; that there was an accumulation of gas in the lower workings, in consequence of the upsetting of a train in the doorway; that this gas was exploded by the unlawful exposure of a naked light by a collier; that if the rules made by the managers had been observed by their subordinates, the explosion might not have happened; that culpable neglect was shown by Rawson and Lawson in violating the rules which had been framed for the protection of life and property; that Nicholls should adopt some means whereby the observations of rules should be more strictly enforced, and that Government should appoint additional inspectors. In the Oaks case the decision was that Richard Hunt and others were killed by an explosion of gas at the Oaks Colliery, but that there was no evidence to show how it ignited. The jury added, "that they thought it was unnecessary to make special recommendations respecting the working of mines, as Government was then collecting information with a view to a better protection of life;

but they considered more strict inspection desirable."

This was an allusion to the action that was being taken by Government, which ultimately culminated in the Coal Mines Regulation Act of 1872, which is administered by inspectors. Among the chief provisions of the Act were the following:—(1) Females and boys under ten are not allowed to work underground; (2) Boys between ten and twelve are not allowed to work except in thin mines; (3) No boy under twelve to drive a gin-horse, or under eighteen a steam-engine; (4) Wages not to be paid at public-houses; (5) Working of mines by a single shaft prohibited; (6) Managers to be certificated as competent by a Board of Examiners; (7) Annual return of coal wrought to be made to Inspectors; (8) Notices of accident to be sent to Inspector; (9) Openings of abandoned workings to be fenced; (10) Plans to be kept up to within six months of date; (11) Plans of abandoned mines to be deposited with Home Office; (12) General rules for the safety of miners in fiery mines, management of ventilation, safety lamps, and gunpowder, protection against accidents in shafts and levels, &c.; and, (13) Power to frame special rules, subject to approval of the Secretary of State.

Other "accidents" have, however, rendered further legislation necessary, and, in consequence, the Coal Mines, &c., Regulation Bill of 1887, backed by Mr. Secretary Matthews and Mr. Stuart-Wortley, was framed and passed. It consolidates previous measures and adds a few more technical restrictions.

In the very year following the awful lesson of the Staffordshire pit, about 178 lives were lost, on the 8th of November, at Ferndale Colliery, Rhonnda Valley, near Cardiff, owing to naked lights. Staffordshire was again the scene of a disaster, attributable to carelessness, at the Black Lake Colliery, on the 25th of January, 1872. At Morley, near Dewsbury and Leeds, thirty-four deaths were also caused on the 7th of October in that year, owing to "great carelessness and bad discipline," and in the following month twenty-two colliers were drowned through the influx of water into an old working at Pelsall Hall, Walsall. Gross ignorance or "culpable carelessness" was responsible for an explosion by which fifty-four were killed at Astly pit, Dukinfield, near Manchester, on the 14th of April, 1874; twenty-three were killed on the 20th of November at Rawmarsh Colliery, near Rotherham, through naked lights.

The following year was the occasion of the Swaithe Main disaster, near Barnsley. Like so many of these occurrences, it happened in the month of December, and in the same week no fewer than three other colliery explosions took place, making the total mortality within the seven days upwards of 200 men and boys, 140 of whom were killed in the first-named calamity. The year 1877 was remarkable for several features in connection with the mining casualties of that period. Heroism in the face of exceptional and extreme danger is a characteristic of our race, and never has it been more abundantly manifested than in the attempts to aid the subterranean workers when entombed by explosion, overtaken by after-damp, or when locked in by an ever-increasing flood of water cutting off their approach to the shaft. But the occurrence at the Tynewydd Pit, in the Rhonnda Valley, is a romance unique in the history of coal-mining. On the 11th of April, just as the day's work was over, and the men were already beginning to make their way towards the shaft to be raised to the surface, they were terrified by a rush of roaring waters. The narrow roadways of the pit suddenly became rushing streams, the water surging in, as one of the escaped men described, "like a rough sea dashing upon a stony beach." Many forced their way through the flood to the bottom of the shaft; and when they had been raised to the surface it was found when the muster roll was called that fourteen (men and boys) were missing. An exploring party immediately descended, and found that though the shaft itself was clear the workings were full. Every roadway leading from that central point to the remote parts of the pit was full of water to the crown of the arch. It was at once concluded that all those who had not escaped were drowned; but while the exploring party were consulting some faint knockings were heard, and it was conjectured that the men, who were thus proved to be alive, were behind a wall of coal some thirty feet thick. A vigorous effort was at once begun to cut through the wall, and was seconded by the imprisoned men themselves. The work was continued all night, and next day the courageous rescuers and the imprisoned miners were able just to hear each other's voices. A hole was made into the stall or heading in which the men had been shut up. They were eagerly pressing forward; but such was the density of the air in their prison, forced in as it was by the pressure of the water behind, that as soon as the rock was pierced it broke out, thrusting one of the men into the hole through which he was about to escape, and inflicting such injuries that he died. Four other men were, however, rescued and brought to the bank. But nine men were still missing. Anxious search and listening revealed no sign of them till the afternoon of the second day, when a faint knocking was heard; but it was estimated that between the immured colliers and the farthest point which it was possible for the explorers to reach there were 300 yards of narrow archway filled with water to the crown. Pumping with powerful engines was resorted to. Toiling night and day did not seem to affect the level at all. An attempt was then made to reach the poor prisoners by divers; but they could do nothing but convey some little refreshment to their tomb and encourage them. The resolution to cut through the coal was taken on Monday afternoon, the 16th, five days after the disaster. There were forty yards to cut, and it was feared that a repetition of what had occurred at the previous rescue might kill both prisoners and rescuers. Undaunted, however, the latter worked away as before, night and day. On Friday afternoon two brave fellows, Abraham Todd and Isaac Pride, were the last to cut the coal. The latter struck the hole through the last blow by which the men were liberated. Todd jumped in, as he said afterwards in his own words: "Then I asked them, 'Where are you?' for I had no light, the managers having refused to give us lamps. George Jenkins then came on to me and caught hold of me, and I then felt his arms round my neck, and he kissed me repeatedly. When he left me Moses Powell did the same. I asked where the other men were, and they replied 'Behind.' I then called my butty, Isaac Pride, to come in, which he did. I then went to where John Thomas was, and I caught hold of him. He was sitting down on a lump of coal, apparently lifeless, with his head hanging down. I said to him, 'John, don't you know me?' and he said, 'Yes,' and that was all I heard them speak." A small quantity of dirty water and a little grease, which dropped from the box containing the candles, was all the sustenance the prisoners had. The Queen conferred upon the noble band of rescuers the Albert Medal, an honour never before bestowed for other than gallantry in saving life at sea.

On the 11th of October, at King Pit, Pemberton, near Wigan, an explosion resulted in the loss of thirty-three lives. Exploring parties were prevented penetrating the workings by the after-damp, although the manager, Mr. Watkin, a certificated manager, Mr. Cook, and one of the underlookers lost their lives by heroically attempting to do so. An explosion at High Blantyre, near Glasgow, in the same month, resulted in the death of 200 miners; but this terrible total was exceeded by the Ebbw Vale calamity, near Newport (Mon.), on the 11th of September, 1878. The cause of this accident, like that in so many cases, will never be known; but the victims numbered 268. Risca, also in Monmouthshire, was the scene of an explosion in 1880, at which there were 120 deaths, whilst at the Seaham Pit, near Durham, in September of the same year, 170 lost their lives.

It would appear that the various legislative efforts, and the general improvements in the strictness with which regulations are enforced, combined with the better scientific apparatus, and increased technical knowledge in the management of mines, have all conduced to the reduction in the number of accidents, and a decrease in the loss of life. A summary of official figures shows that, during the year 1886, the aggregate number of persons employed in and about the whole of the mines in the United Kingdom of Great Britain and Ireland amounted to 561,676. Of these 520,632 were employed under the Coal Mines Regulation Act, and 41,044 under the Metalliferous Mines Regulation Act. The total number of fatal accidents was 866, and the total number of deaths occasioned thereby 1,214, showing a decrease compared with the total of the previous year of 51 in the number, and an increase of 216 in the number of lives lost. This report also shows that, on an average during the year, there was one fatal accident to every 648 persons employed. The proportion of fatal accidents to the number of persons employed is lower than the average of the last ten years, and the death-rate is also lower.

CHAPTER XIII.

LAND TRAVEL AND ITS RISKS.

TRAVEL dangers have altered their character as our methods of locomotion have undergone development. Anterior to the railway era the risks attending progression from place to place were mainly those caused by imperfect roads, although the liability to personal attack by lawless adventurers had also to be taken into serious account. In some countries the latter danger still remains a painful reality, for, while brigandage survives as a terror to travellers in certain parts of Eastern and Southern Europe, and while railway trains are open to the sudden onslaughts of robber gangs in the Western regions of America, it cannot be said that this element of risk has altogether disappeared. Confining ourselves to our own country, however, we may look upon the highwayman as an extinct species. He was a picturesque villain, and gave many a touch of melodrama and romance to the slow-paced life and motion of our forefathers, but he found his occupation gone when the iron horse whistled his way through the length and breadth of the land; and the garotter and footpad of our later time hardly come even into the remotest comparison with him. The moral character of Claude Duval was probably not one whit better than that of Bill Sikes; still we are now so far removed from him that we can afford to regard him with less abhorrence than we regard the latter. The dangers of travel by land, apart from railway travelling, are not now, it must be admitted, very great; in the crowded thoroughfares of our large cities and towns, where conveyances of every description thread their way in and out amidst the throng of people, accidents and fatalities are of frequent occurrence; but out on the high roads between town and town there is little to fear in the way of mishap; bad roads are very few, road vehicles are of good construction, and bad driving is not common. The risks of the rail, therefore, are the only land travel risks which assume any particular importance in these days, and the danger in this direction has been so much reduced of late years that, to use the words of Mr. Bright, a railway carriage would seem to be to-day about the safest place in the world. Never a year passes, it is true, that there is not some railway accident to record, in which there has been great loss of life; but when it is considered that over 600,000,000 of passengers are conveyed over the lines of the United Kingdom every year, the percentage of fatalities is exceedingly small. In fact, the Annual Report for 1886 on the Railways of the United Kingdom goes far to support the view that a man's life is rarely in less peril than when he is travelling by rail. The figures show that the chances against a passenger being killed by causes beyond his own control, while making an average railway journey, are just one hundred and eight millions to one, and against his being injured, either slightly or seriously, one million four hundred thousand to one. It will be an interesting task to trace the growth of the various safeguards and appliances by which this condition of affairs has been brought about, and to describe the present working of the railway system.

First of all, we may take a bird's-eye view of the old coaching days, and the roads over which the numerous conveyances had then to travel. Of the latter Macaulay has given an interesting picture, while of the former Mr. Stanley Harris, Lord William Lennox, Mr. James Hissey, and other stagers, have written with graphic effect. A more recent writer, too, in the *English Illustrated Magazine*, has portrayed something of the old dangers, difficulties, romances, and excitements of the road. He refers to the first stage-coach journey from the famous "Bell Savage on Ludgate Hill in London." It was the "Flying Machine," that made it from the metropolis to Bath, and it was in that portion of the seventeenth century when "woodcocks were killed in Regent Street, in which bears danced and bulls were baited in Lincoln's Inn Fields, in which the dead cats and dogs of Westminster were shot into St. James's Square." No wonder, under these circumstances, that coach-riding was not a bed of roses, for the roads were in as dangerous a condition as they could well be. "Long before the Flying Machine had cleared the metropolis—the metropolis which knew Chelsea as a quiet country village with a thousand inhabitants, Marylebone as a space where cattle fed, and sportsmen wandered—the six inside passengers had been twice nearly upset and shaken out of their seven senses; and it had scarcely begun its creeping passage over Hounslow Heath when it was stopped abruptly, and the six inside passengers had their six purses taken away" by the great highwayman already mentioned. The French page of the Duke of Richmond was then in the height of his fame, which considerably outshone that of any knight of the road who succeeded him. The dashing Augustin King, educated at Cambridge, and hung at Colchester; the great William Nevison, whose name still haunts the hamlets of the Northern moors, hung at York; the magnanimous Bliss, hung at Salisbury; the Brothers Weston, the Peaces of the last century, who frequented the best society at Winchelsea, and robbed in the surrounding country, hung at Tyburn—a cultured pair, whose lives were pleasant, and in death they were not divided—none of them, not even Turpin himself, the Turpin whose ride to York has been labelled by Macaulay a myth, seem to have attained to what Mr. W. Outram Tristram describes as "that high standard of elegant rascality displayed by this importation from France." Claude Duval, after his death, was the subject of some "Memoirs," from which the following extract may serve to demonstrate that "elegant rascality" of which Mr. Tristram speaks:—He, with his Squadron, overtakes a Coach which they had set over Night, having Intelligence of a Booty of four hundred pounds in it. In the Coach was a Knight, his Lady, and only one serving maid, who, perceiving five Horsemen making up to them, presently imagined that they were beset; and they were confirmed in this Apprehension by seeing them whisper to one another, and ride backwards and forwards. The Lady, to show that she was not afraid, takes a flageolet out of her pocket and plays. Du Vall takes the hint, plays also upon a flageolet of his own, and in this Posture he rides up to the Coach side. "Sir," says he to the Person in the Coach, "your Lady plays excellently, and I doubt not but that she dances as well. Will you please to walk out of the Coach and let me have the Honour to dance one Currant with her upon the Heath?" "Sir," said the Person in the Coach, "I dare not deny anything to one of your Quality and good Mind. You seem a Gentleman, and your request is very reasonable." Which said, the Lacquey opens the Boot, out comes the Knight, Du Vall leaps lightly off his horse and hands the Lady out of the Coach. They danced, and here it was that Du Vall performed Marvels; the best master in London, except those that are French, not being able to show such footing as he did in his great French Riding Boots. The Dancing being over (there being no violin, Du Vall sang the Currant himself) he waits on the Lady to her Coach. As the Knight was going in says Du Vall to him, "Sir, you have forgot to pay the Musick." "No, I have not," replies the Knight; and putting his Hand under the seat of the Coach, pulls out a Hundred Pounds in a Bag and delivers it to him, which Du Vall took with a very good grace, and courteously answered, "Sir, you are liberal, and shall have no cause to repent your being so; this Liberality of yours shall excuse you the other Three Hundred Pounds," and, giving the word that if he met with any more of the Crew he might pass undisturbed, he civilly takes his leave of him. He manifested his agility of body by lightly dismounting off his horse, and with Ease and Freedom getting up again, when he took his leave; his excellent Deportment by his incomparable Dancing and his graceful manner of taking the Hundred Pounds.

The state of the roads in the seventeenth and eighteenth centuries was as dangerous to life and limb as the ruffianly tribe of highwaymen were to the purse and valuables. In early spring and winter especially the roads must have been terrible. So late as 1797 Middleton, in his survey of Middlesex, speaking of the Oxford road at Uxbridge, observes that during the whole of the winter there was only one passable track on it, and that was less than six feet wide, and was eight inches deep in fluid sludge. All the rest of the road was from a foot to eighteen inches deep in adhesive mud!" Earlier, the roads were chiefly remarkable for larger quantities of adhesive mud; and there is small wonder that the first Flying Machine, like all its successors on the roads, whether North, West, East, or South, was very frequently stuck fast, and required numerous carthorses and other extraneous help to pull it on firm land again.

Omnibuses were a means of locomotion which grew up contemporaneously with stage coaches, and before regular passenger trains. The first omnibus which plied successfully in this country was started in London, and its journey was between the Bank of England and the "Yorkshire Stingo," at Paddington. Mr. George Shillibeer was the pioneer of the venture, which was inaugurated in June, 1829. His omnibus occasioned much annoyance to the proprietors of the old-fashioned stage coaches, with whose slow and unpunctual journeys the public were soon weary, when a contrast both in cheapness and accommodation was afforded them. Mr. Shillibeer next started omnibuses from Paddington to the Bank, and these took the route of the other great artery of London, west to east, viz., Oxford Street, Holborn, and Cheapside; a third line was commenced from Greenwich to the West End of London; and a fourth and last was traversed by a diligence between Brighton and London. The original coach proprietors at this time found that they must either compete with Shillibeer or give up business wholly. They decided on the former expedient, and ultimately ruined Shillibeer. They built superior and lighter omnibuses than those he had introduced; nevertheless, they were enormously heavy, and weighed more when empty than our modern vehicles do when full. They were drawn by three horses abreast; the conductors displayed themselves in velvet caps and jackets, and one notable auxiliary towards the comfort and entertainment of travellers was a library of books within the omnibuses. Soon after Shillibeer's failure omnibuses became general, and with this increase of public accommodation commenced a system of disgraceful competition, which for years made our legal courts the scenes of success or failure equally disgraceful, filled the Law Reports with cases, and led to the enactment of those various Parliamentary Bills which, from the Act 4 William IV. to the most recent regulations enforced under municipal authority, have at last succeeded in modifying the original evils, and mitigating the dangers to passengers which were a consequence of the competition. It is singular to reflect in this connection that the earlier Acts betray, by their mere wording, a recognition by Parliament of the competitive evil. A proprietor of some note after Shillibeer, named Bray, who commenced running omnibuses in London, indicted the whole of the original proprietors at the Central Criminal Court for conspiracy. They were found guilty and sentenced to pay a fine of nearly £1,000. At length, after a large amount of legal warfare, and the loss of immense sums of money, most of the old and new proprietary of that particular line of road coalesced and established what was the foundation of the largest metropolitan omnibus company. Until a larger coalition of interests took place, however, the opposing proprietaries and their servants constantly took the law into their own hands, and indescribable scenes of confusion, furious driving, injury to the horses and carriages, and the arrest of both conductors and drivers on false or petty charges, and often while in the very act of duty, varied more or less the early days of omnibus history. With the wise combination of opposing interests and between hostile parties may be reckoned the beginning of those improvements which up to the present day have carried on this extraordinary branch of metropolitan locomotion, and as omnibuses increased their circle so did London stretch out its breadth and length.

But it is the railway system that has caused the most startling developments of the past half century. And it is somewhat remarkable, in considering the immense passenger traffic of to-day, that railways were not originally designed for anything but goods traffic. The earliest railways that were worked by locomotive engines were constructed in the North of England and in Wales. The first of these—the Stockton and Darlington Railway—was projected by Mr. Edward Pease, and constructed by George Stephenson. It was designed entirely for the conveyance of minerals, and without any idea of embracing passenger traffic as well. The second important line—the Liverpool and Manchester—was also designed to carry goods and mineral traffic, passengers being a subordinate consideration. The combination of the locomotive and the rails, or what we now call the "permanent way," proved the immense economy that was practicable in the transport of heavy materials, and may be said to have thereby revolutionized the great mineral trade of the country, yet it was not for some time after the invention of the locomotive that it was used upon the railways which had long been constructed. Mr. Clement E. Stretton, in his interesting work on "Safe Railway Working," completely demolishes the popular impression that railways came suddenly into existence as a complete system at the time when the Liverpool and Manchester line was opened in 1830. The railways of the present day are, he points out, the out-growth of the wonderful development of the ancient tramways. The discovery that a horse could draw a much greater load upon a hard level surface than upon an ordinary road led to the introduction of "stone tracks," which consisted of long narrow flagstones placed in parallel lines, upon which the cart wheels ran. More than two hundred and fifty years ago a Mr. Beaumont introduced the "wooden way" to facilitate the conveyance of coal from the Newcastle collieries to the docks, and he also introduced four-wheeled waggons in the place of the ordinary carts. Of this invention it is mentioned, in the "Life of Lord Keeper North," "that the carriage is so easy that one horse will draw down four or five caldrons of coal, and is an immense benefit to the coal merchants." Mr. Stretton enters minutely into the ancient and modern character of "permanent ways"; and it may not be out of place, in our task of briefly tracing the growth of the railway system generally, to give an outline of what he somewhat technically elaborates. In course of time the "wooden ways" were so much worn by the waggon wheels that, instead of entirely replacing the old ones, new planks were nailed upon them. This plan was subsequently followed by the system of "plating" the wooden tracks with sheet iron, or by nailing iron plates or bars upon them—hence the designation of "plate-ways," and of the men employed to lay them down as "platelayers." The reverse effect was then experienced—the iron plates wore out the wooden waggon wheels, with the result that about the year 1753 cast iron wheels were introduced. Between this time and the dawn of the nineteenth century the improvements in railroads were numerous. One of the greatest of them was introduced on a line at Loughborough, in Leicestershire, by Mr. William Jessop, who abandoned the flat wheels and flanged rails, and introduced iron rails with a flat top, and wheels with a flange cast upon the tyre. Tramways began to be numerous, and inventors appeared rapidly with some new contrivance to render them more efficient for the accomplishment of their work. A tramroad was constructed from Wandsworth to Croydon in 1801, in regard to which Sir Richard Phillips wrote: "I found delight in witnessing at Wandsworth the economy of horse labour of the iron railway, and thought such lines should be extended from London to Edinburgh, Glasgow, Holyhead, Milford, Falmouth, Yarmouth, Dover and Portsmouth." But, generally speaking, the idea that railways should be laid over the country was considered at that time to be perfectly absurd, and it is a very hackneyed story of the way in which the suggestion of utilizing railways for passengers was received, even among the august and far-seeing gentlemen who then occupied St. Stephen's in the capacity of senators. George Stephenson was to the fore as an inventor long antecedent to the Stockton and Darlington era. He was, however, made engineer of that railway scheme, which may be regarded as the legitimate pioneer of the gigantic system of the present day, and in 1818 application was made to Parliament for its approval. Twice the Bill was rejected, but it passed in 1821, and on the 27th of September the line was opened. Even at that time it was not intended to work the line with locomotives, and some fixed engines and ropes were provided, but the locomotive was not long in demonstrating its superiority over all other systems. Stephenson was also appointed engineer to the Liverpool and Manchester Railway, which was opened to the public on the 15th September, 1830, and it was some little time before the opening that the question as to locomotive *versus* fixed engines and ropes had to be decided by the directors. Notwithstanding reports and opinions, the directors did not feel able to come to a decision, when one of their number proposed "That a reward be publicly offered for the most likely mode of effecting their object." It was accordingly resolved, on the 20th of April, 1829, to offer a premium of £500 for the best locomotive engine, subject to eight conditions as to weight, load, pressure of steam, price, &c. The month of October was fixed for the trial, and the "running ground" was on the Manchester side of Rainhill Bridge, and the following engines were entered for the prize:—The Rocket, the Novelty, the Sans Pareil, and the Perseverance. The respective makers were George Stephenson; Braithwaite and Erickson; Hackworth; Burstall. The trial lasted from the 8th to the 14th of the month, when the Rocket was adjudicated to be the best engine, and as it had performed all the conditions and stipulations required by the Company, Stephenson obtained the £500. Thus the Rainhill trials of 1829 settled the locomotive question, and led to the introduction of railways throughout the world. The impetus then given to construction was nothing short of marvellous, for in twenty years there were in operation in different parts of the globe a total length of 18,656 miles of railway, on which a capital of £368,567,000 had been actually expended. Besides this, there were, at the same epoch, in process of construction a further extent of 7,829 miles, the cost of which when completed would be £146,750,000. Thus within the period of a quarter of a century 26,485 miles of railway had been constructed; or, to better realize the aggregate, we may say a greater length than would completely surround the globe, at an involved outlay of five hundred millions sterling. To accomplish this stupendous work in the time, human industry must have appropriated out of its annual savings twenty million pounds for twenty-five successive years. Now, in the United Kingdom alone, the number of miles of railway open is nearly twenty thousand, while the capital paid up and raised amounts to more than eight hundred millions sterling.

Probably there could not be much legitimate surprise manifested at the occurrence of accidents in the earliest period of passenger trains, but it was an unfortunate circumstance that the very opening of what was termed the Grand British Experimental Railway, in 1830, was darkened by a fatal accident to Mr. W. Huskisson, M.P. From that time to this catastrophes have been frequent, although there is some satisfaction in contemplating that different devices (more elaborately dealt with in the next chapter) have reduced almost to a minimum the danger to the passenger freights which are ever and anon being sent with extraordinary speed from one point of the compass to another. Trains running off the line were responsible for the first railway disasters, among which were those at Great Corby, in December, 1836; Cuckfield, on the London and Brighton line, in October, 1841; and at Sonninghill cutting, near Reading, on the 24th of December in the same year. It was in 1842 that the first very serious disaster happened, and it was at Versailles. The carriages took fire, and the passengers being locked in, over fifty lives were lost. Experiences of this sort have since been repeated both at home and abroad. In 1868 the accident at Abergele occurred, and in that instance there were trucks carrying petroleum, which, by some inadvertence, were allowed to become detached from the engine which was drawing them, and ran down hill at a rapid pace until they met the Irish mail advancing in the opposite direction on the same line of rails. The crash was, of course, tremendous; but before those who were uninjured in the front of the train could descend from their damaged carriages the petroleum caught light by the engine fire, and all the fore part of the train was enveloped in a fiery mantle. It was thought that most of the passengers in the carriages had escaped, as few cries of help were heard, and those soon ceased. When, however, the flames were subdued the horrifying fact was revealed that thirty-three human beings had perished—many of them suffocated as they sat bolt-upright in their seats. This accident directly arose through the uncoupling of the runaway trucks from their engine, and the Government Report dealt severely with the practice on some railway lines of allowing rules formed for the protection of passengers to be habitually broken. Again, in 1887, was this cause of danger to the travelling public brought to mind by an appalling accident which occurred in Canada to an excursion train travelling between Port Stanley on Lake Erie and St. Thomas, a town about ten miles distant from the Lake. In all its elements the accident appeared to be as simple as it could be. An excursion train loaded with passengers was returning from the shores of Lake Erie when it reached a spot where another set of lines crossed the main track. This spot was in the heart of the city of St. Thomas, just as the main lines of the great English companies still run through on a level crossing the High Street of the city of Lincoln. By some blunder, a freight or luggage train was allowed to cross over in front of the passenger train, and before it had got clear of the main lines the latter had dashed into it, cutting it in halves. The first two cars of the excursion train were smashed, and no doubt many deaths would have been recorded if this had been the only extent of the accident. But the luggage train was carrying tanks full of petroleum, whose highly inflammable nature need scarcely be explained. These tanks were burst open, and in a few minutes the oil caught fire, and the whole of the front portion of the train was enveloped in a sheet of roaring flame. Efforts were made to rescue the wounded who were lying in the wreck, but before help could reach them the flames had enveloped them and done their worst. It is impossible to conceive of any disaster which can exceed in horror a scene of this kind. Willing hands are always ready to pull the injured from the mass of splintered woodwork when a railway accident occurs, but when the site of a collision becomes in a few minutes an inferno of flame, the best endeavours of rescuers are useless. The terrible nature of such an event consists in the fact that nothing can be done, and that the fire advances remorselessly on the men, women, and children who are lying crushed under the *débris*. It is not astonishing that the "air is rent with cries of agony"; indeed, the scene is agonizing enough even to the onlookers. The amount of oil which broke loose in the St. Thomas catastrophe must have been very considerable, as the flames at one time actually threatened the town itself.

Incidents of this kind, or rather accidents, have given rise frequently to the consideration and discussion of the problem of how far we can be protected from their recurrence. In spite of all that has been written and spoken on the question, there are not many of our railway companies that have established, or that are likely to establish, the system of separate rails for goods traffic. Petroleum is known to be as dangerous as gunpowder, so that by law a license is necessary for keeping it in large quantities, and without such license not more than forty gallons may be stored within fifty yards of a dwelling-house or warehouse. The Abergele accident, as we have seen, took place in 1868, and in 1871 Parliament decided that wherever petroleum was carried by land, the vessel containing it should be labelled with the name of the substance, and the words "Highly inflammable," and with the names of the consignor and consignee. The fact, however, that an inflammable oil, exuding a death-dealing vapour, is so labelled, would not protect the public from the consequences if a repetition of the Abergele or Canadian accidents were to occur. Not much consolation can be derived from the circumstance that carriages in England are warmed by a different system to that which exists in America, and that no fire is to be found about our trains except in the locomotive furnace itself. In the first place, the most recent calamity of the character to which we at present allude, like the Abergele disaster, occurred in the very height of the summer, when it was as hot in London, Ontario, as in London, England, and when, therefore, no such thing as a fire for warming the atmosphere is at all necessary. Then it should be remembered that any light of the smallest and feeblest description is enough to set fire to the fumes of petroleum released from the tank in which the substance is being conveyed—and there must be lights in railway trains to illuminate in tunnels and at night time. When an accident occurs the glass which protects these lamps is shattered, and the flames are therefore free to come into contact with any floating vapour in the neighbourhood. There is, therefore, not much doubt that this special danger still exists in England. We are still liable to have a passenger train coming into collision with a luggage train on which explosive oil is conveyed, and the lamps at the top of our carriages or the engine furnace are quite capable of setting fire to the oil, and enveloping the whole train as at Abergele. It is, of course, impossible to guard altogether against this peril, except by banishing the oil tanks altogether from the lines. The use of electricity would make the danger much less; but even supposing we reach a period when no lights which could set inflammable oils on fire are carried in any passenger carriage, there is still the engine fire, which can hardly be done away with, and which by itself may produce the dreaded catastrophe.

As the railway system grew, and when the permanent ways became safer and more efficient, collisions became the principal danger of railway travelling, and these arose from a variety of causes. In October, 1845, the Leeds Commissioner of Bankruptcy was killed in a collision, which a coroner's inquest declared to be due to "indistinctness of the tail lights, owing to the fog, but chiefly from the gross negligence and recklessness of the engineer, Wheatley," against whom the jury returned a verdict of manslaughter. The next year, in the eastern counties, a collision is recorded to have "arisen from mismanagement on the part of the company's officers, who had removed the experienced signalman from a station, which was very badly placed, leaving it in charge of a boy, and from their having permitted an engine-fitter to take charge of the train as engine-driver, in which responsible station they sometimes employ their mechanical engineers, and without taking proper care that they have received the regulations laid down for their guidance. It appeared that some of the servants on the line had never seen the regulations at all." There is a curious analogy between this event—the coroner's court returned a verdict "that the accident had arisen from the reckless driving of William Clare"—and that accident which saddened the last day of the 1887 Doncaster race meeting. Twenty-four people were killed at Hexthorpe, and fifty more grievously injured, because two men charged with the conduct of an important passenger train, at a time when the line was burdened with an extraordinary excess of traffic, had not taken the trouble to read the special regulations which had been furnished for the occasion, nor had looked out for the special signals that had been appointed for that particular day. This, of course, is the most severe way of condensing the facts relating to a collision which in English railway history had not many equals in the shape of casualties. There is another standpoint from which to view the Doncaster collision, and that is one which is at once derogatory to the higher officials, whom coroners' courts do not seem to be able to reach, nor yet who trouble much about the obvious lessons of such catastrophes. Under the block system (a system explained in the succeeding chapter) it should be impossible for a train to run into the one before it, and the fewness of such accidents since the system came into general use proves its value. Why, then, was it suspended between Hexthorpe and Doncaster when there was an extra press of traffic? Simply in order that the extra traffic might be more expeditiously worked. More trains can be conducted over a given space of line in a given time by hand-signalling than by the block system, and consequently on the St. Leger and Cup days the railway authorities were in the habit of sacrificing safety to speed. It does not matter that in regard to this particular accident under notice the companies had taken every precaution in the way of giving notice of the intended suspension of the block system to the employés concerned; they had no right to suspend a scientific safeguard of such efficiency for the purpose of increasing dividends or facilitating the rate of locomotion. In all such cases, however, the final blame falls upon the employés, and in this instance the driver and fireman were visited with a similar verdict to that we have referred to of more than forty years before. Nevertheless, there are few unprejudiced observers who will disagree with the opinion of that experienced and eminently practical engineer, Mr. Robert Stannard, when he wrote upon this phase of the Hexthorpe calamity, that "much pity and some excuse should be made for these poor fellows, remembering that it was their *first blunder*, and in the interests of a body of men who have served me faithfully for over forty years I must say that in this late disaster it is my opinion that the railway authorities were quite to blame, inasmuch as at times of extra pressure of traffic, such as occurred during the race week at Doncaster, it should be made a point by the officials to *read over to the drivers any fresh and suddenly-conceived alterations that may be needed.* Nothing of the kind was done in this case, and, I imagine, not even thought of."

The catalogue of railway disasters in this country presents many distressing features, illustrating in some instances the most culpable negligence of proper precautions, and in others the impossibility of always preventing such occurrences. At Dixonfold, on the Lancashire and Yorkshire line, on the 4th of March, 1853, while a train was proceeding at the rate of from forty to fifty miles an hour, one of the driving wheels of the engine broke short off, and the engine and three of the carriages were hurled off the rails, with the most terrible results. Seven persons were killed and many injured. Here again the driver was found guilty of manslaughter, on the ground that he had driven at an undue speed, and the coroner's jury condemned the condition of the railway engines and the management of the company. Numerous other railway accidents happened from 1853 to 1857, by which many lives were sacrificed. A cow crossing the rails at Attleborough, in Warwickshire, on the 10th of May, 1858, threw a train off the line, causing three deaths. On the 23rd of August of the same year, a Sunday-school excursion train on the Oxford and Wolverhampton Railway, carrying over 2,000 persons of both sexes, met with a lamentable accident. The train had been divided, and one engine was attached to each division, instead of having one in front and one in the rear of the whole. Both portions of the train proceeded safely as far as Round Oak Station, situate on a steep incline, when a coupling broke, and eighteen rear carriages of the first portion ran back into the second, causing the death of fourteen people. After a protracted investigation the jury condemned the whole arrangements of the company, and a verdict of "manslaughter" was recorded against the guard, though in the course of the inquiry it appeared that one probable reason of the non-efficiency of the brake was that the compartment of the carriage in which the machine was managed was so crowded with children that there was great difficulty in handling it. Six persons were killed at Tottenham by an accident caused by the breaking of an engine-wheel, on the 20th of February, 1860; 23 persons were killed, and 176 injured, in the Clayton Tunnel accident, on the London and Brighton line, in August, 1861; 16 were killed and 320 injured in the following month at Kentish Town; and on the 30th of May, 1863, 4 passengers were killed and 30 injured by the explosion of a locomotive boiler, near Streatham, on the London and Brighton line, through attempting too great a speed. Some carriages of a train were upset near Lynn, on the 3rd of August, 1863, through a bullock straying on to the line, 5 persons being killed. Insecure rails caused two serious accidents in June, 1865; one on a branch of the Great Western near Rednal, when 13 people were killed and 40 injured; and the other near Staplehurst, on the South-Eastern, in which 10 were killed and 50 injured. It was in the last-named accident that Charles Dickens happened to be, and he subsequently wrote a thrilling narrative of the unfortunate affair. The breaking of axles and tires has been another fruitful source of disaster. On the 25th February, 1867, a carriage axle belonging to a goods train on the Lancaster and Carlisle Railway broke, causing a collision with another goods train, and the firing of 5 tons of gunpowder, though, fortunately, with only the loss of 2 lives. A similar cause led to the sad collision at Newark, on the 21st June, 1870, by which 19 deaths occurred. In December of the same year a tire broke on a Great Northern train at Bell Bar, near Hatfield, when the break and carriages were overturned, and 8 lives lost. Four persons met their deaths on the 8th May, 1873, by the breaking of an engine axle, near Shrewsbury; and in the following month 2 people were killed by the breaking of an engine tire on the Midland line near Higham. The terrible disaster at Shipton, near Oxford, on the Great Western line, on the 24th December, 1874, by which 34 lives were sacrificed, and about 70 injured, was caused by the breaking of a carriage tire. One of the most serious of recent accidents of this nature was that which occurred near Penistone, on the Manchester, Sheffield, and Lincolnshire Railway, on the 16th July, 1884. The express from Manchester, running at the rate of 50 miles an hour, was hurled to destruction by the sudden snapping of the right-hand axle-bar of the engine. The engine, tender, and horse-box left the line, ploughing up the road for about 400 yards; and the rest of the train, consisting of 7 composite carriages, were thrown over the embankment, 30 feet high, and overturned, three being reduced to splinters. Nineteen passengers were killed on the spot, 6 died subsequently, and more than 50 suffered severe injuries. By far the largest number of accidents are caused by the giving way of axles or tires; in 1885 there were 377 failures of axles, and 920 failures of tires.

Collisions caused by defective signalling are, happily, a less numerous class of accident than in the earlier years of the railway system, and might be fewer still by the legislative enforcement of the absolute block system on all lines. Occasional instances occur of accidents by the failure of brake apparatus, but since the general adoption of automatic continuous brakes accidents of this kind are much fewer. A terrible disaster took place on the 13th of January, 1882, in the suburbs of New York, in consequence of the disarrangement of the air brake attached to a train returning from Albany to the capital, conveying many members of the legislature. The train was unable to proceed, and the brakesman ran back along the line to signal a local train which was known to be following; but he had not gone many yards before the local train swept round a curve at full speed, and dashed clean through the rear car of the first train. Other cars were overturned, and the stoves set fire to the wreck. Several passengers were burned to death within sight, hearing, and touch of the horrified bystanders, who were only able to pile snow upon the burning masses. A tragic incident of this catastrophe was the death of

Senator Wagner, the inventor of the parlour-cars known by his name. He started back to see that the red danger signals were properly displayed, and literally walked into the jaws of death. A year later an equally horrible accident happened on the Southern Pacific line to a train which had left San Francisco for New York. The train had stopped on the summit of the Sierra Nevada, but from some unexplained cause began to run back, and in a few seconds the impetus was so strong that the brakes were unable to hold it, and it ran on down the steep declivity for five miles, when it broke from the rails and was precipitated with a tremendous crash over the embankment, fifteen feet high. The whole train, except two cars, which ran on a couple of miles farther, fell in a heap and took fire. Some thirty lives were lost in this terrible accident. Many minor accidents have occurred in this country through the failure of brake power.

Another prolific source of disaster on railways—especially in America—has been the failure of bridges. The saddest calamity of this description in the annals of British railways was that which occurred on the 28th of December, 1879, at Tay Bridge, when a passenger train and a large portion of the bridge were blown into the river, over seventy lives being sacrificed. A long official inquiry followed, it being the following July before the report of the Court of Inquiry was published, when the opinion was expressed that the bridge had been badly designed, badly constructed, and badly maintained, and that its downfall was due to inherent defects, which sooner or later must have proved fatal. On the 17th of June, 1880, a goods train on the Hereford, Hay, and Brecon Railway was precipitated into the river Wye through the giving way of a bridge as the train was crossing. The engine-driver was killed.

On the Morelos Railway, in Mexico, on the 25th of June, 1881, the supports of a bridge over a mountain gorge gave way, and a troop-train fell into the abyss, a cargo of alcohol catching fire and exploding, thirteen officers and 125 men being killed or burnt to death. By the breakdown of a bridge over the Drave, near Eggey, in Hungary, on the 25th of September, 1882, a train fell through into the river, causing the deaths of twenty-five persons. On the 27th of November, 1882, a train from Macduff to Aberdeen, passing over a bridge across the Turriff turnpike, fell partially through by the giving way of the bridge, five lives being lost. Upwards of a hundred persons were killed by the collapse of a railway bridge over which a train was passing across the Alendia River, on the Ciudad Real line, on the 26th of April, 1884, the engine and carriages falling into the water twenty-five feet below. On the 2nd of July in the same year, at a place called Cunningham, near St. Louis, the railway bridge over the river fell in while a train was passing over it, and the engine and six cars were hurled into the river beneath, a distance of forty feet, resulting in the loss of fifteen lives. It would indeed require many pages to simply catalogue the long list of similar disasters which have occurred in the United States, for it is only within the last few years that any attempt has been made in America to construct railway bridges on anything like principles of solidity and security.

Collisions are the most serious of all railway accidents, and often arise from mistakes made by signalmen or pointsmen; but where the block system prevails there is a double protection, and the number of accidents of this nature is, it is satisfactory to know, gradually diminishing as that system receives extension. But with all our increased precautions the list of fatalities even in the most favourable year is very large. According to the report presented to the Board of Trade for the year ending 31st of December, 1885, there were no fewer than 957 persons killed, and 3,467 injured on railways during that year, as against 1,134 killed and 4,100 injured in 1884. The following summary of accidents, compiled by Mr. Stretton, gives a classification of the various kinds of accidents which make up the total for 1885:—35 collisions between passenger trains or parts thereof; 53 collisions between passenger trains and goods trains; 22 collisions between goods trains or parts thereof; 65 cases of passenger trains or parts thereof leaving the rails; 9 cases of goods trains or parts thereof leaving the rails; 11 cases of trains travelling in the wrong direction through facing points; 14 cases of trains running into stations at too high a speed; 126 cases of trains running over cattle; 48 instances of trains running through gates at level crossings; 377 failures of axles; 3 failures of brake apparatus; 6 failures of couplings; 920 failures of tires; 1 failure of a wheel; 3 failures of ropes used in working inclines; 2 failures of bridges; 287 broken rails; 9 cases of flooding of permanent way; 8 slips in cuttings or embankments; 10 fires in trains.

Other accidents occurring on railway premises during 1885 brought the totals up to 997 persons killed and 7,022 injured. The total for 1886 was 989 killed and 7,407 injured. The accidents to trains, rolling-stock, and the permanent way resulted, in 1886, in 8 passengers being killed and 615 being injured; 4 railway servants being killed and 81 injured from the same causes. There were 103 collisions in all in that year, though these contributed but slightly to the grand totals of the railway bills of mortality.

There are other causes that, like sickness in war, make the larger part of the account of loss. Of persons not in the employ of the companies no fewer than 505 were killed and 914 injured from these other causes. The worst sufferers are, however, the railway servants, as many as 421 of these unfortunate employés being killed and 1,929 injured in one class of accidents alone. The weakest point in the existing system of precautions is the neglect which is shown in regard to the lives of the men in the service of the various companies. It is in such matters as loading, unloading and shunting that the greater number of these casualties happen.

CHAPTER XIV.

RAILWAY PRECAUTIONS AND SAFEGUARDS.

Before proceeding to describe what the railway companies have done towards protecting passengers by their lines from accident it will be well to set forth what the best authorities consider to be the requirements necessary to obtain the greatest amount of security consistent with expeditious travelling. This cannot probably be done better than by summarizing the suggestions for safe railway working made by the Amalgamated Society of Railway Servants of the United Kingdom in the month of January, 1886. These suggestions are twenty-three in number, and run as follows:—1. It goes without saying that bridges, tunnels, stations, permanent way, and works must be properly constructed and efficiently maintained. 2. All railways ought to be worked on the absolute block system, *strictly carried out*, so that no two trains of any kind shall ever be in one section at one time. 3. The block and interlocking systems should be electrically combined and controlled, so that the safety of a block section shall be under the control of two signalmen. 4. The block working at all junctions should be arranged so that no two trains which can foul each other at the points and crossings shall ever be allowed to approach a junction at one and the same time. All sidings and goods lines joining main lines should be provided with properly interlocked safety points. 5. Efficient signals should be employed, and the posts ought always to be placed upon the left-hand side of the line to which they refer. At large stations and junctions short arms or discs should be provided for controlling shunting operations, in order to avoid that most dangerous but common practice, hand-signalling. 6. One code of block system regulations, and one pattern of signal, should be adopted throughout the kingdom. All distant signals of the old-fashioned disc or board pattern should be at once replaced by the usual "swallow-tail" arm. A red light should be the *only* danger signal. The practice of using purple or other lights is highly dangerous. 7. Facing points ought to be avoided as far as possible. All facing points, and points leading to main lines, ought to be provided with a locking bar and bolt, and properly interlocked with the signals and with the electric apparatus. 8. At all junctions not only should the levers be locked in the box, but an actual lock should be placed upon the arm itself at the top of the signal post; and in every case where electric repeaters are used they should work from the *arm itself*, not from the rod in the usual way. 9. All passenger trains ought to be provided with an efficient automatic continuous brake, having brake blocks upon the wheels of the engine, tender, and every vehicle throughout the train, and fulfilling the five conditions laid down by the Board of Trade, August 30th, 1877, and highly approved by the society. To avoid the present dangerous practice of brake-power being cut off and rendered useless by the introduction of an unfitted vehicle, it ought to be the law that one company shall not be allowed to send vehicles over the line of another company unless such said vehicle is provided with the same form of continuous brake as that used by such foreign company. 10. All goods engines should be fitted with brakes upon their wheels, and those occasionally required for passenger traffic should have continuous brakes. On lines having heavy inclines goods and mineral trains should have two guards' vans and two guards. 11. Tank engines should not run with the coal bunker in front; they should be turned, like a tender engine, and always run chimney first. Tank engines should never be run at express speed, as they are unsafe at such speed. 12. All passenger trains should be fitted with efficient means of communication with the driver and guards. Passengers should be able to reach it without putting their hands outside the window. The present cord system is unreliable, and the plan of having no communication on trains which stop every twenty miles is very risky to the public. 13. All passenger platforms should be raised to the standard height, and all carriages fitted with a high continuous footboard, to avoid persons falling between platforms and trains. 14. The crank or driving axles of locomotive engines should be taken out after they have run a certain mileage. What the mileage limit should be ought to be at once decided by the companies and the Board of Trade. The society consider 200,000 miles for iron and 180,000 miles for steel a very reasonable and safe suggestion for full consideration. 15. All tires should be fastened to their wheels, so that if they break they cannot fly off. 16. All curves of ten chains' radius and under should be provided with check rails. 17. At all important junctions, to avoid the up main line being crossed by the down branch, or *vice versâ*, it is very advisable that the branch line be carried over a bridge and brought down to the main line level, as done at Finsbury Park and a few other junctions. 18. All waggons should be fitted with a coupling, so that waggons could be coupled or uncoupled without a man having to go between the vehicles. 19. Overwork on railways is highly dangerous, and ought to be abolished. Ten hours a day is plenty, and proper time for rest ought to be allowed between each term of duty. Eight hours of signal-box work, considering its importance, should be enough; and at very large and busy junctions six hours at a stretch is as much as should be required. 20. Companies' rule-books should be revised, and all rules not intended to be carried out should be removed. 21. Unpunctuality of trains is a great cause of accidents. When an important passenger train is running late the working time-table is rendered useless, as none of the trains booked to shunt at various sidings do so, but proceed to some other siding, and are therefore unable to work as booked. When it is found, day after day, that certain trains do not keep time, the time-table should be properly altered in accordance with the actual running or time necessary. 22. In case of fogs, great care ought to be taken that the fog signalmen are sent out early enough; but it is to be hoped that at no very distant date one of the various mechanical appliances will be adopted in place of fogmen. 23. All inclines should be provided with "catch points" to prevent vehicles running away.

If we compare these various suggestions with the existing condition of things on railways, we shall arrive at some idea of the manner in which the dangers of railway travelling have been met. As regards the construction of the lines and the maintenance of the permanent way, little need be said. In the early days of railways, engineers were much exercised in the matter of the selection of the most suitable form of rails. At first error was made by a too great rigidity of permanent way, but it was gradually made apparent that a certain elasticity was necessary to be given to it to ensure a thoroughly successful running. Stone blocks were largely in use in place of wooden sleepers, for the first twenty years of railway traffic ; cast-iron was also largely experimented with in this connection, but here again the rigidity was too great, and in course of time the arrangement of rails, sleepers, "chairs," and road-bed now in general use came to be adopted, steel rails superseding iron, and other well-known improvements having been effected, one of the latest being a steel permanent way designed by Mr. F. W. Webb, and now in course of trial on several lines with good results so far.

We now come to what may be considered the most important part of the system of protection which has been slowly built up in connection with our railway organization, and that is the system of signalling. The story of the gradual development of this system, from the first primitive hand-signal regulations to the present elaborate block system arrangement, would be too long a story to give here ; it must suffice, therefore, that we attempt to describe what the block system, which has been so largely adopted and must necessarily come to be universally used, really means.

So far back as the year 1843, Sir W. Fothergill Cooke practically applied this system, based on the principles of the needle telegraph, in the Queen Street Tunnel, Glasgow ; to him, therefore, may be credited the invention of this great protective organization. The next application of the principle was made by Mr. Edwin Clark, who adopted what is called the permissive block system on the London and North-Western Railway, which consisted in checking the speed of the following train if it trenched too closely upon its predecessor. This, however, did not give absolute security. Mr. C. V. Walker made another step in advance on the South-Eastern Railway, by introducing a bell-signal system; and still later Mr. W. H. Preece, for many years chief electrician on the South-Western Railway, worked out a system of visual signals, which were placed in the signal-box, and gave an absolute reflex of what occurred outside, and, in some cases, out of the signalman's sight. Mr. Preece's system was first introduced on the South-Western Railway, at Exeter, in 1860. The apparatus by which the signalling was carried on was a beautiful combination of electrical and mechanical principles. It supplied, first, a communication between two stations by which notice of the approach, progress, and departure of trains and their character was given; secondly, it afforded a "danger" and "all clear" signal for protecting and guiding the trains on each line of rails; thirdly, it gave the signalman at one station the sole and complete control over the signal at the other station, and rendered it impossible for him to interfere with or alter the signal in his own box; fourthly, it ensured the proper acknowledgment of every signal, and that the acknowledgment should not only imply the due receipt of the signal sent, but that it had been properly understood and properly acted upon; fifthly, that the apparatus employed should be unaffected by those atmospheric and cosmical causes which were so injurious to telegraphs generally; and, lastly, it provided that any derangement of the apparatus, or accidental delivery of a false signal, either by the signalman himself or by the mechanical interruptions to which wires are liable, should at once indicate danger and produce safety. From the time of the introduction of Mr. Preece's system, the development of the block system of signalling was very rapid, and at the present time, out of 18,338 miles of line in the United Kingdom, there are 14,639 miles worked on the absolute block system, leaving a balance of 3,317 miles which are still worked upon insecure principles.

What is understood by the block system is the absolute preservation of a definite space between the trains running on a line of railway, so that each train is protected from the one immediately following it by this interval. It has been objected that the term "block" system is not strictly correct, and that it should have been "space" system. The practice of the system depends for its success upon the degree of perfection to which the apparatus used in carrying it out has been brought, the simplicity of the operations its working involves, the exactness of the rules and regulations devised for its working, and the efficiency of the discipline prevailing. There are several systems of block working in operation, but after the serious accident at Canonbury Tunnel caused by the conflict of two different codes, the leading companies saw the advantage of adopting a more uniform system, and this came into use towards the end of 1884. For the purposes of the block system the line is divided into sections, varying in length from a few chains to four or five miles, according to the amount of traffic that has to be passed over it. A signal-box is placed at the end of each section, and is provided with electric bells and block telegraph instruments for working the traffic in each direction. Each signal-box is further provided with "Up" and "Down," "Distant," "Home," and "Starting" signals, and "Lie By" or shunting sidings are constructed at such places as it is found necessary to allow a fast or important train to pass a slow train. Following Mr. Stretton's description of the method of signalling, it may be explained that on the approach of a train to signal-box A, the signalman there will call the attention of the signalman at B, and then give the proper "Is line clear?" bell and dial signals. The signalman at B, after having ascertained that the line is clear for the train to run upon, must repeat the signals; and when he has received the necessary intimation from A that he has repeated the dial-signal correctly, which intimation must not be given by A until the bell-signal has also been correctly repeated, he must peg the needle to "Line clear." The train may then be despatched from A. As soon as the train has passed A, the signalman there must call the attention of, and give the bell-signal "Train entering section," to B, and the signalman at B must acknowledge the signal and unpeg the needle. The signalman at A must then give to B the proper "Train entering section" dial-signal, and when the signalman at B has acknowledged that signal and received the necessary intimation from A that his acknowledgment is correct, he must peg the needle to "Train on line," and then call the attention of, and give the "Is line clear?" signal to C. As soon as the train has passed B, it must be signalled, as above directed, to C, and the signalman C must in like manner call the attention of, and forward the "Is line clear?" signals to D, and so on throughout the block system. If the second train should arrive at a signal-box before the preceding one has been signalled as "Out of section," it must be brought to a stand and detained at the starting-signal until such time as the section ahead is clear.

In 1856 the system of the Interlocking of Points and Signals was invented by Mr. Saxby. Previous to that time-points were worked by levers in the ground, and were perfectly independent of the signals, and it frequently happened that signals were lowered when points were in the wrong position. By Mr. Saxby's invention the point and signal levers were brought together and interlocked so that it was impossible for an "all right" signal to be given which was not in accordance with the position of the point-levers; and successful steps have been more recently adopted for combining the block and interlocking systems; it is unnecessary, however, to go further into the details of the signal system, the establishment of the block system leaving little to be desired in the way of protective measures of this kind. The adoption of the system has involved the various companies in a great outlay, the sum of £750,000 having been spent by the London and North-Western Railway Company alone upon the construction of block signals and stations, up to the end of 1877; but the companies have been more than compensated for this expenditure by the saving effected in avoidance of the more serious loss which would probably have been entailed by accidents that would have resulted if the old system had been continued. Trains moving under the block system have their way prepared before them, and their passage carefully guarded behind them, reducing the element of human fallibility to a minimum.

Passing over the question of the pattern of signals, the colours of lights, and the matter of facing-points, we now come to the next most important consideration in railway safeguards—that of brakes. Progress in this direction was for many years very slow. Hand brakes upon tenders and guards' vans were considered sufficient for a long time; then came mechanical and non-automatic continuous brakes, which were slow in action, and were liable to fail at any moment. Self-acting brakes were the next great step in advance, and in their later developments every engine, tender, and car to which these are applied carries its own store of brake-power ready for instant use, so that if every coupling in the train were to be broken, each vehicle would stop itself. Under the direction of the Royal Commission on Railway Accidents, a series of brake trials took place at Newark, in June, 1875, the following companies taking part in the trials:—The Midland with the Westinghouse Automatic Brake; the Lancashire and Yorkshire with the Fay; the London and North-Western with the Clark and Webb; the Great Northern with the Smith Vacuum; the Caledonian with the Steel McInnes; the London, Brighton, and South Coast with the Westinghouse Vacuum; the Midland again with a Barker Hydraulic; and the Lancashire and Yorkshire again with a Fay and a North-Eastern engine. Out of these trials the Westinghouse Automatic came first; the Fay and North-Eastern engine second; and the Clark and Webb third. Numerous other experiments followed, and continuous brakes were soon largely adopted; and so important was the question that in 1879 Parliament required the companies to make returns as to these matters. Since then each half-year's statistics show an increasing amount of brake-power in use. In 1880 only thirty-six per cent. of our railway carriages had been fitted with continuous brakes, and only seven per cent. of them had brakes of a kind considered as efficient by the Board of Trade. At the present time eighty-six per cent. of carriages are fitted with continuous brakes, although thirty-two per cent. of these do not meet all the requirements of the Board of Trade. The brakes which satisfy these conditions are the Westinghouse Automatic, the Automatic Vacuum, the Steel McInnes, and the Automatic Friction. The two first-named, however, appear to be the real competitors. The Brighton line, the North-Eastern, the Great Eastern, the Caledonian, and the North British rely on the Westinghouse; the Great Western, the Lancashire and Yorkshire, the London and South-Western, and the Midland patronize the Automatic Vacuum. The Midland has seventy-eight per cent. of its vehicles fitted with the Automatic Vacuum, five per cent. with the Westinghouse, and four with Smith's Vacuum. This last-named brake is returned as only complying with some of the requirements of the Board of Trade. It is the brake in use on the Great Northern Railway, on most of the South-Eastern stock, on the Metropolitan line, on the Cheshire lines, and by several Irish railway companies. It is not self-acting. Certain East Coast joint stock is returned by the Great Northern Company as fitted with both Vacuum and Westinghouse brakes. The London and North-Western adheres to the Clark and Webb's, and the brake known simply as the Vacuum. The entire stock of the Metropolitan District Company is fitted with the Westinghouse non-automatic, or air-pressure brake. The London, Chatham, and Dover appear to have only ten per cent. of their vehicles fitted with continuous brakes, mostly the Westinghouse.

The authority previously quoted summarizes the qualities of the two leading brake inventions with considerable clearness. The action of the Westinghouse, or pressure system, it is explained, is based upon the use of compressed air, or pressure greater than the 15 lbs. of the atmosphere; whereas the vacuum system is applied by the force of the atmosphere acting upon one side of a piston, from the opposite side of which about 12 lbs. of the atmospheric pressure has been purposely drawn out or removed. The Westinghouse brake is continuous throughout the train, and is operated by compressed air stored in a main reservoir on the engine, and in small reservoirs, one upon each engine, tender, and carriage, all connected by a pipe running the length of the train. There is also on each vehicle a triple valve and brake-cyclinder, with pistons connected to the brake-levers. Maintaining the pressure in the brake-pipe keeps the brakes off; but letting the air escape from the brake-pipe, purposely or accidentally, instantly applies the brakes, by allowing air to pass from the small reservoirs into the brake-cylinders. The automatic vacuum brake is worked by atmospheric pressure of about twenty-four inches of mercury, or 12 lbs. per square inch. This partial vacuum is obtained by means of a steam-worked ejector fixed upon the engine, and supplied with steam from the locomotive boiler. The action of the ejector is inductive, the effect of the steam jet being to draw out the air from the train-pipe and all vessels in connection therewith. Beneath each vehicle in the train is fixed a cylinder, which is in communication with the train-pipe. When the steam is turned through the ejector all these cylinders are emptied of their contents; but when from any cause, whether the accidental division of the train or the intentional act of the driver or guard, air is admitted to the train-pipe, a small ball-valve is caused by the rush of air to change its position, by doing which the passage from the train-pipe to one side of the piston is closed, whilst the other side is left open to the train-pipe. The piston is thus out of equilibrium, and the unbalanced pressure upon its under side forces it up, and brings the brake blocks to bear upon the wheels. When it is desired to release the brakes the air-inlet valves are closed, and the ejector being set to work again, draws out the air from the train-pipe and cylinders. As soon as the pressure on the under side of the piston is reduced to an equality with that on the top side, the ball-valve opens the top side passage to the train-pipe, and the two sides of the piston being in equilibrium, the brakes fall off the wheels by their own weight and the weight of the descending piston. Hence, in running, a vacuum is maintained throughout all the pipes and cylinders by means of the ejector, and the brakes are applied by destroying the vacuum on one side only of the brake pistons.

Notwithstanding all these safeguards, however, the casualties on railways are more numerous and more serious each year than necessary. Among those of 1886 which gave rise to official inquiries were twenty-five collisions which were classed as having occurred "within fixed signals," at stations or sidings, and which resulted in the loss of two passengers and one servant of the company killed, and 256 passengers and thirty servants injured. Eight of these casualties were reported to be mainly due to mistakes of signalmen in block-working, arising from forgetfulness or want of care. Two others were due to the combined mistakes of signalmen and engine-drivers; six arose mainly from want of care on the part of engine-drivers running their trains at too high a speed, or not having them under proper control, or not keeping a proper look-out for signals. It is fair to drivers and guards to note that some of these accidents occurred under very trying circumstances—in densely foggy weather, for instance, or during heavy snowstorms, which caused the breakdown of the telegraph wires, and the suspension of the block system of working. With regard to the inefficiency of the system of fog-signalling at present in use, Major General Hutchinson has from time to time strongly advocated the adoption by the railway companies of some uniform mechanical or electric device. Numerous schemes have been suggested, but so far an absolutely reliable working of the signal has not been sufficiently assured in any one of them to lead to its adoption. There is, besides, a serious difficulty in the way. This arises from the fact that, owing to the considerable interchange of traffic, joint action on the part of the railway companies becomes absolutely necessary. If, for example, the Great Northern Railway Company decided to adopt any special system, then a certain number of the locomotives belonging to each of the eleven or twelve companies that have running powers on sections of the line would have to be fitted with the same apparatus as that chosen ; and if other trunk lines were to choose different systems, it might even be necessary for the same locomotive to be furnished with appliances for two or three methods of signalling. It seems probable, however, that unanimous action on the part of the companies may be secured, for towards the close of 1887 Sir Edward Watkin took steps for the formation of a committee of representative railway men for the express purpose of agreeing on the selection of a system. Besides this question of unanimity, there is the difficulty of the initial cost, which would have to be incurred in the general adoption of any new system ; and in these days of depression in trade, with diminished traffic resulting therefrom, it is no easy matter for railway directors to sanction a large expenditure, even upon improvements in the mode of operating such traffic. The introduction of the block system was opposed at first because of the great cost implied by its adoption ; yet at the present time, as we have seen, there is no single company of importance which does not consider it essential for the safe conduct of traffic, and which does not regard the outlay as one of their wisest investments. The expense attendant on the introduction of an efficient method of fog-signalling would, however, be insignificant compared with that involved on adopting the block system; and even this initial cost would be saved in a short time, when regard is had to the sums now spent in doing the work imperfectly. It has been stated on good authority that the cost of a single night's fog-signalling on the Lancashire and Yorkshire Railway may be estimated at £500; and to this may be added the inconvenience of collecting the platelayers and getting them to their stations at a moment's notice, either for a few minutes or for hours together. In regarding the economical side of the question, the loss sustained by accidents arising from the inefficiency of the present system must be taken into account. There was a notable illustration of this in the Hornsey accident, which is said to have cost the company £30,000 in compensation for loss of life, injuries, legal charges, and damages to rolling-stock. At the inquiry into the cause of the accident the engine-driver said, "Although the fog was very bad, there were no fogmen out at all," and the station-master explained that "the fog came on so suddenly that he had not time to send out the platelayers before the accident occurred."

The frequency of accidents to individuals in getting in and out of railway carriages has rendered obvious the necessity for continuous footboards, which are only thoroughly efficient when they are *level* with the platform. There is a large proportion of the travelling public who are either too impulsive or too headstrong to observe regulations laid down for their protection, and it is necessary to adopt every mechanical contrivance that is calculated to preserve them from their folly. Entering and alighting from trains in motion are some of the commonest faults, and the continuous footboard has often saved offenders from fatal consequences. Other appliances designed for the protection as well as the comfort of passengers are the communicating cord, and the elaborate system of lighting the trains.

With regard to the latter subject, the disaster which happened to a train at Wannsee, near Berlin, in June, 1887, called attention to a new kind of accident, which is as instructive as it was without precedent. Trains have often been burnt. In the United States, indeed, burning is the necessary complement of almost every collision, in consequence of the stoves which heat the carriages being overturned; but at Wannsee the conflagration was caused neither by stoves nor oil, but by gas. One excursion train ran into the last carriage of another which happened to be lit with gas. The shock burst the gas-bag, and in a moment the carriage was a mass of flames, with the result that three persons were quickly consumed, and seven others severely burned. There is no particular reason why this disaster might not be repeated in England at any time, unless the railway companies endeavour to make such changes in their lighting arrangements as may prevent an accident from being necessarily a holocaust.

Upon the Lancashire and Yorkshire Railway for some time several of the express trains have been lighted with electricity, while in America the electric light and a steam-heating arrangement have been adopted on several lines. There is, however, still plenty of room for a good deal of invention in the matter of lighting, inasmuch as at present the use of the electric light is very expensive. Storage batteries are objectionable, besides being expensive, on account of the dead weight to be carried by the train, but there are at least two other systems which promise to be successful. In one of these, small dynamos are driven direct from the axles, and in the other the dynamo is mounted on the locomotive, and driven by a small engine supplied with steam from the boiler. In the latter case connections have to be made whenever the locomotive is separated from the train, as must be the case on long journeys; and in the former, the current ceases and with it the light, whenever the train stops. In a matter of this kind it is obvious that the system which is found to be most certain in working will be adopted, just as eventually we look forward to a general establishment of every safeguard which may minimize the danger of travelling behind the iron horse.

PART IV.

MAN AT STRIFE.

MAN AT STRIFE.

CHAPTER XV.

THE CHANCES OF WAR.

"The exercise of violence under sovereign command," which constitutes war, has indeed an ancient history. The first warlike king, we are told, was Osymandyas, who conquered Bactria more than two thousand years before Christ, and it has been computed that since his initiative venture there have been sacrificed by belligerent countries considerably more than seven billions of human beings. And in all warfare, probably more in modern conflicts than in primitive times, results have to a large degree been governed by "chances," which neither science nor the development of modern modes of warfare could have controlled. We are well aware that the science of war includes many different branches; that there are so many necessary reflections to be made, so many causes and circumstances to be brought together, that it is only by a continual application, grounded upon the love of his duty, and an inclination to his profession, that any man can attain to success in it. We know, too, that to march an army into every sort of country, whether open, woody, or mountainous; to know how to form a camp in all those countries with which a general must be well acquainted in order to do it with security; to make a proper disposition for a battle, whether with a view to the posture of an enemy, or to the situation of the country; to be capable of making a good retreat on a proper occasion; to direct the forages without fatiguing or exposing the troops; to send out detachments with precaution; to conduct the convoys in safety; to know how to canton an army, are all great ends in military science. To the perfection in these things of our English military and naval heroes we owe much of our supremacy on land and sea. Nevertheless, many of the decisive battles of history have been governed by events which depended in a manner upon chance, that troublesome element which will always be liable to crop up so long as what Erasmus called "the malady of princes" is the arbiter of international differences.

Mediæval warfare has not received so much attention from the historian as the military system which may be said to have replaced it in the fourteenth century, and which, with various modifications, has prevailed to the present time, and in which the foot-soldiers constitute, as in the Roman legions, the chief element. But there were great captains and highly-disciplined and formidable armies before then. The battle of Hastings, and the subsequent reign of William the Conqueror, naturally form the first mighty landmark in English history; then come the exploits of Richard Cœur de Lion, who was the most brilliant and accomplished soldier of his age. Afterwards were the wars of the Scottish Independence, and through the next five hundred years there was a continuity in military organization, the essential part of which has been the performance of the greater part of the real work in war by infantry, to which arm the cavalry and artillery have been, with some exceptions, merely auxiliary. Mr. R. H. Clinton, in his valuable book "Crécy to Assye," gives a very interesting chapter upon the army reorganization that was accomplished. Under the feudal system, the feudal militia were organized, and every freeman, by a statute enacted in the reign of Edward III., became familiar with the use of arms, while the force available for offensive purposes consisted of the Military Tenants of the Crown, who, with their vassals, were obliged to attend the King in war for a term of forty days in each year. This period of embodiment, however, was quite inadequate for a continental war, from the time occupied in crossing and returning, and the English sovereigns therefore accepted pecuniary aid in lieu of personal services, which enabled them to engage archers, light-armed infantry, and light cavalry, from among their subjects or foreigners. Nothing in the nature of a standing army existed at this time. Up to Edward III., Mr. Clinton tells us, the strength of the offensive force lay in the cavalry, whether heavy or light, and "as little value was set on the infantry, the archers, and billmen as on the artificers (masons, smiths, tentmakers, &c.), who were generally obtained by 'impressment.'" The heavy-armed cavalry consisted of the barons and their knightly retainers. Plate-mail had superseded to a great extent chain-mail, and horses as well as men were covered with defensive armour. Helmet, breast and back plates, greaves, and gauntlets loaded the warrior, while his charger was covered with plates, or chain-mail on the neck, breast, and haunches, and masked with a chanfron, from which an iron spike projected in the middle of the forehead. Each mounted soldier had a sword and a long lance, and sometimes a heavy mace, which was slung from the saddle-bow. The writer already quoted describes the "flower of the foot" to be "the archers, who were sturdy yeomen equipped with a long bow of yew, a sheaf of twenty-four aspen arrows (which were feathered from the wing of a goose or peacock), and for side-arms—to be used when his missiles were exhausted—a sword or a short battle-axe, or a murderous brownbill." They wore a buckler, steel head-dress, and they had some portions of their clothing strengthened with mail. The rest of the foot-soldiers were light infantry, armed with long knives, and furnished with skull-caps, quilted jackets, and iron gloves.

Edward III. inaugurated a new custom. He created troops by indenture; a proper rate of pay was fixed for the archer who volunteered into the service, and as the remuneration exceeded that of the artisan the services of a sufficient number of men were easily enlisted. Officers were available from the existing knights, and thus a drilled army, approximating to the modern model—"a mass of men skilled in the use of military weapons, and taught to act in concert, was created; an army in which the bowmen, the fore-runners of the musketeers and riflemen of modern times, were to take the most important part." In course of time the introduction of firearms demolished archery as a chief factor in subsequent battles.

Rude cannon of brass and iron, and huge machines like the ancient catapults, were requisitioned after the use of gunpowder became in any degree understood, and with these implements besiegers used to batter the gates and walls of a city with great masses of stone. Progress in the improvement of firearms was, however, slow, due possibly to a conservative military prejudice founded on the fact that all the great victories had been won by the bow. Even to the close of the sixteenth century the bow continued to be the weapon of a considerable portion of the soldiers. Firearms had been served out to the militia, and had been used by them for some years, and pistols had been adopted by the French cavalry in 1544; but they had not yet come into use among the English, and hand mortars and grenades were still a novelty in the infantry. This was the condition of things at the time of the Spanish Armada. Subsequently the development of firearms was very rapid, and it is the idea of some economists, which statistics seem to prove, that their progress and universal use rendered battles less sanguinary.

During the second half of the present century more murderous science has been bestowed on warfare than ever before. The chief feature of military history for twenty years of the period was the vast improvements effected in firearms. We passed, by successive stages, from smooth bore muskets of short range, inaccurate firing and slow loading, to rifles of long range, great accuracy, and rapid firing. In artillery the advance was proportionate, and yet the result has been that the proportion of killed and wounded was far greater with the old-fashioned weapons than it is in the present day. A few facts are sufficient to demonstrate this. At the battle of Talavera, in 1809, the loss in killed and wounded was one-eighth of those engaged; at Austerlitz, in 1805, it was one-seventh; at Malplaquet, in 1709, at Prague, in 1759, and at Jena, in 1806, it was one-sixth. At Friedland and Waterloo, in 1807 and 1815 respectively, the loss was one-fifth; at Marengo, in 1800, one-fourth. At Salamanca, in 1812, out of 90,000 combatants 30,000 were killed and wounded. In the same year, at Borodino, 25,000 out of 80,000 fell on the two sides. At Leipsic, in 1813, the

French sustained a loss of one-third of their total effective force; at Preussich-Eylau, in 1807, 55,000 were killed and wounded out of a combined total of 160,000 combatants, giving a loss of more than one-third; while at Zorndorf, in 1758, the most murderous battle which history records in modern times, out of 82,000 Russian and Prussian troops engaged, 32,800 were stretched upon the field at the close of the day. Now let us come to the contrast. The first great battle in which rifled firearms were used was that of Solferino, in 1859, and when the war broke out it was confidently predicted that the effects of the new weapon would be frightful; but the loss actually fell to one-eleventh of those engaged. At Königgrätz, where, in addition to rifled weapons, one side was armed with breechloaders, the actual loss was further diminished to one-fifteenth. Finally, we may take the Franco-Prussian war, in which the proportions were—Worth, one-eleventh; Gravelotte, one-twelfth; and Sedan, one-tenth. This was the war, too, in which the death-dealing mitraileuse was brought into action. Statistics such as these may doubtless surprise many who not unnaturally have imagined that improved weapons entailed increased slaughter. Battles are still sanguinary, of course; but they are much less so than they were, and not a tithe so ferocious.

Another point of view from which it is evident that the soldier's life is more jealously guarded now, is the great social feature of the present-day pace. Everything goes ahead, and armies conform to the rapid order of things. Military operations and results which used to occupy years are now compressed into months, or even weeks. The war of 1859 was declared by Austria on April 26; the first action, Montebello, was fought on May 19th, and the war was finished at Solferino on July 24th. In 1866 the Prussians virtually declared war by crossing the Austrian frontier on June 23rd, and in seven weeks the latter power was forced to come to terms at the very gates of her capital. Prussia received the French declaration of war on July 19th, 1870. On the 2nd of September France's last army in the field was destroyed at Sedan, and the last shots were fired on February 2nd, 1871. Here then we have at once, as a writer in *Fraser's Magazine* pointed out five years later, an immense saving of life. The long delays, which meant for the soldiers exposure to the weather and to sickness; the defective communications, entailing insufficient food; the slowly dragging campaign, with all its privations and hardships—all these fertile sources of disease and death have vanished, and are vanishing. It is true that the French soldiers, both in and out of Metz, suffered terribly from want of proper food and supplies, but their administration was bad, and the very magnitude of their defects will prevent a repetition of them.

To pause, for comparison, we may take one or two instances from the wars of the first Napoleon. What was the state of his army during the invasion of Russia in 1812, and before meeting the enemy otherwise than in small skirmishes?—"From the want of magazines and the impossibility of conveying an adequate supply of provisions for so immense a host, disorders of every kind had accumulated in a frightful manner on the flanks and rear of the army. Neither bread nor spirits could be had; the flesh of overdriven animals and bad water constituted the sole subsistence of the soldiers, and before a great part of the army had even seen the enemy, it had undergone a loss greater than might have been expected from the most bloody campaign. When the stragglers and sick were added to the killed and wounded the total reached 100,000." Again: Massena entered Portugal in October, 1810; spent weeks and weeks in futile examination of the lines of Torres Vedras, and recrossed into Spain on the 3rd of April, 1811, "having lost 30,000 men by want, sickness, and the sword." As the only action of any importance that occurred during the retreat was that of Barossa, at which the French loss was under one thousand, it does not require much calculation to estimate the proportion of mortality due to "want and sickness." Such protracted neglect and suffering would be impossible now.

It is not merely on the battle-field, either, that the soldier's risk is now diminished, but throughout the whole campaign. Railways afford a more adequate supply of medical and other necessaries to the front, and a more rapid transfer of the sick and wounded to the permanent hospitals. Explosive bullets are forbidden. The International Military Commission, which in November, 1868, signed the Declaration of St. Petersburg, demonstrated the length to which the spirit of mitigating the horrors of war had extended. This spirit, evinced so far back as 1759, when Admiral Conflans told his captains not to use shells, but only *les armes généralement employées par les nations policées*, was emphasized by the Declaration, that not only renounced the use of any projectile which was explosible, or charged with inflammable matter, and was of a less weight than 400 grammes; but also laid down as a general principle that the sole object of war being to place *hors de combat* the largest possible number of the enemy's troops, the use of weapons the peculiarity of which was merely to increase mortality and suffering was contrary to humanity. The Conference at Brussels in 1874 was a further attempt towards the mitigation of the "rigours of warfare," but unfortunately it closed without important results.

The tendency of modern warfare would appear to be towards establishing a result to be decisive for the war in which it occurs. Thus, the struggle should be fought at or near the frontier, and should be final, for national superiority emphatically demonstrated cannot be gainsaid or set aside. Austria, in 1866, saw and accepted the inevitable in time to save herself, and had France done the same in 1870, at least humanity would have been the better served. The only effect of her protracted resistance was to place her more and more at the mercy of the conqueror, and to prolong almost indefinitely that period for a renewal of the struggle and of revenge, for which it is generally presumed she is waiting.

We may now turn to that movement, the adoption of the principle of which would avoid any sacrifice of life in warfare—viz., the movement for the promotion of permanent and universal peace. After the long agony of the Continental war had been brought to an end by the peace of 1816, the country had enjoyed comparative rest for many years in its foreign relations. There was a distinct growth of pacific sentiments in Europe, until after the accession of the Whigs (which was at first deemed an additional guarantee for peace), when a change in our foreign policy brought about wars and rumours of wars. An increase of taxes was asked for to enable Government to reorganize the militia, and considerably to increase the armaments, and a community of philanthropists, notably members of the Society of Friends, felt themselves bound to resist such proposals. In addition to the Peace Society, then in existence, the National Defences Committee was formed, expressly for the purpose of evoking public feeling against the measures of the Government, with the result that the Militia Bill was withdrawn. Having achieved this immediate object, the friends of peace began another movement of a more definite nature. They had frequently memorialized our own and other governments in favour of arbitration, and Mr. Cobden, towards the close of 1848, gave notice of his intention to propose during the following Session an address to Her Majesty praying that she would direct the Secretary of State for Foreign Affairs to enter into communication with Foreign Powers inviting them to concur in treaties binding the respective parties, in the event of future misunderstanding, which could not be arranged amicably, to refer the matter in dispute to the decision of arbitration. Arbitration was accordingly launched as a plank of a political platform on the sea of public opinion; and when Mr. Cobden's motion came to a division, seventy-nine votes were recorded in its favour. Encouraged by their success, the peace advocates got up an International Peace Congress, which was held at Brussels in 1848, and in which the moving spirits were Mr. Joseph Sturge, Mr. Elihu Burritt, who had distinguished himself in America by his writings on peace, and M. Auguste Visschers, who subsequently acquired a European reputation as a *savant* and philanthropist. This was the first of that series of Peace Congresses which have since been held in different centres of Europe, the object of which was not to proclaim the advent of a millennium of universal peace, as it was the pleasure of many opponents to represent. "They sprung," says Mr. Henry Richard in his Memoirs of Joseph Sturge, "from a precisely opposite conviction, the conviction that unless some measures were taken by governments and peoples, during the lucid interval of comparative European peace they were then enjoying, to provide some other means than the sword for the adjustment of national differences, and to reduce the standing armaments which were growing with such ominous rapidity during peace, there was the most imminent danger that Europe would ere long be again dragged into the vortex of war. They met, not to indulge in premature and sentimental felicitations on the extinction of the evil, but to stimulate each other to labour in their respective countries, and according to the measure of their influence and ability, in support of taking such precautions as might lessen the probability of its recurrence. To this end they recommended that arbitration treaties should be formed between nations; that the principle of non-intervention should be universally adopted; that governments should come to an understanding for a mutual and simultaneous reduction of their armaments; that all encouragement should be given to the improvement of international communication, the extension of postal reform, the adoption of the same standard of weights, measures, and coinage; that those engaged in the education of youth, ministers of religion, and conductors of the public press, should be exhorted to use their influence to eradicate from the minds of men those political prejudices and hereditary hatreds—hatreds which have so often been the cause of war, and to diffuse sentiments of peace and goodwill among the people."

The outbreak of the Russian war, however, in 1854, paralyzed for a time the efforts of the peace party, although some of them, nothing daunted, and with a heroism of purpose by no means worthy the odium that in some quarters was heaped upon them, determined to wait upon the Emperor of Russia in the interests of peace. Mr. Sturge, Mr. Henry Pease, and Mr. Robert Charleton were the gentlemen who went on the mission—who quitted their families to undertake a long and hazardous journey to those regions "where winter barricades the realm of frost." Their intention was laudable, although it failed in accomplishment. They were assailed by violent criticism on their return, and from Mr. Kinglake's History it would appear that although the Emperor had treated them with the utmost consideration, and listened to their representations with something akin to sympathy, yet this feeling afterwards changed into a frenzy of anger against the Friends for having deceived him. Mr. Henry Richard disputes the accuracy of the historian of the Crimea in this particular, or at all events doubts it, citing in opposition to it the fact that after the death of the Emperor, the Empress Dowager, who worshipped the memory of her husband, on more than one occasion, in interviews with members of the Society of Friends, referred to the mission of Mr. Sturge and his companions in a very different tone from what might have been expected had she been aware that the remembrance of it had driven the Emperor to the transport of wrath described by Mr. Kinglake.

When the ill-starred war was over, after there had been left those half million of British, French and Russian men in the Crimea, the representatives of the Great Powers met to settle the terms of peace. The friends of peace again stepped forward. They felt it was a matter of great importance that the principle of stipulated arbitration, for which they had been so long contending, should, if possible, be recognized in the new Treaty, and so become a part, as it were, of the international law of Europe. Lord Palmerston received a deputation from the Peace Congress Committee on the subject; but while acknowledging that "associations like those there represented, though he could not go with them to the full extent, must yet have great influence on the general opinion of mankind, and greatly dispose men to prefer the solid advantages of peace to the more dazzling results of war," his lordship gave little encouragement to the deputation. Notwithstanding this rebuff, the peace party managed through Lord Clarendon to get their representations placed before the Congress of plenipotentiaries sitting in Paris, where a resolution was ultimately passed recognizing the duty of having recourse to arbitration—not indeed in the binding form which the memorialists had ventured to recommend, but still in a form sufficiently distinct and emphatic to give to the great principle the full sanction of that august assembly. It may be of additional interest to add the full text of the protocol:—"The plenipotentiaries do not hesitate to express in the name of their governments the wish that States between which any serious misunderstanding may arise, should before appealing to arms have recourse, so far as circumstances might allow, to the good offices of a friendly power. The plenipotentiaries hope that the governments not represented at the Congress will unite in the sentiment which has inspired the wish recorded in the present protocol." This happy innovation, as Lord Clarendon called the protocol, was subsequently referred to by numerous statesmen. Mr. Gladstone spoke of the proposal to submit international differences to arbitration as a very great triumph—"a powerful engine in behalf of civilization and humanity"—and one which "asserted the supremacy of reason, of justice, of humanity and religion." Lord Derby referred to it as the "principle which, to its endless honour, was embodied in the protocols by the Conference of Paris"; and the Earl of Malmesbury looked upon this act of the Conference as one of the most important to civilization and to the peace of Europe, "because it recognized and established the immortal truth that time, by giving place for reason to operate, is as much a preventive as a healer of hostilities."

The peace party did not relax their energies and their efforts; they started newspapers to advance their principles, and the more prominent of them personally enforced their arguments at many of the courts of Europe with great success.

The more recent progress of international arbitration has been described by Mr. Henry Richard in two papers he read at the conferences of the Association for the Reform and Codification of the Law of Nations at Cologne, and from these we gather some interesting facts relating to the prevention of hostilities, and appropriate to the present chapter. Since the Alabama case was disposed of by the Tribunal of Geneva, there have been numerous instances of the amicable settlement of international differences in the manner suggested by the early members of the peace party. The celebrated Mixed Commission which was to inquire into all outstanding claims made by subjects of Great Britain upon the Government of the United States, and *vice versâ*, had no fewer than 478 claims on the part of the former, and nineteen on the part of the latter, to investigate, and they accomplished their task in a manner that elicited encomiums from the *Times*, which has not always written very favourably of arbitration. That journal added that "we have now discovered how justice can be meted out to individuals, and a difficulty permanently removed without the whole nation being burdened with immeasurable consequences." In 1874, a question that had been in long dispute between England and Portugal, as to the possession of Delagoa Bay and the surrounding territory on the East coast of Africa, was referred to the arbitration of the President of the French Republic. In July, 1875, Marshal MacMahon assigned the disputed territory to Portugal, and the British Government and nation acquiesced almost without a murmur. For many years there had been a dispute between Switzerland and Italy on the question respecting the frontier near Peschiaro, and the two governments referred their difference to the Hon. P. Marsh, the United States Minister at Rome, who pronounced in favour of Italy, Switzerland cheerfully accepting the decision. The same principle was successfully applied in regard to disputed boundary between the territories of Persia and Afghanistan, and what is known as the Seistan Arbitration arrested a possible war between the Shah of Persia and the Ameer of Cabul. Sir Thomas Wade, our British Minister at Pekin, was the arbiter some years ago in a serious quarrel, which threatened at one time to involve fighting between China and Japan, countries which subsequently enlisted the mediation of the late President Grant relative to the sovereignty of the Islands of Loo Choo. The Emperor of Russia acted in the capacity of arbitrator in a dispute in which Japan was again implicated, but this time with Peru; and in the year 1879 Spain and the United States enlisted the services of the Italian Ambassador at Washington to adjudicate between the two governments in reference to certain claims of indemnity put forward by American citizens in Cuba for injuries alleged to have been suffered during the Civil War in that island. Afterwards came the Arbitration of the Halifax (Nova Scotia) Fishery Commission between Great Britain and the United States.

The award was in favour of Great Britain so far as two of the Commissioners were concerned, who adjudged the United States to pay five million dollars, or about a million sterling, to the Canadian fishermen. Mr. Kellog, the United States Commissioner, objected to this finding, and the United States might have refused to be bound by it, yet instead, as Mr. Richard says, of "discrediting the principle of arbitration," they submitted to the award and paid the money. Arbitration, though the British, Italian, and United States governments offered to act, was refused in the dispute between Chili and Peru, with the result that a miserable war was carried on with aggravated barbarity, and to the desolation of South America. The bitter lesson, happily, was not lost upon Chili, for some years later she signed a Convention with Columbia to submit to arbitration all questions in dispute between the two Republics. The offices of the French Court of Cassation were obtained in determining what was known as the Nicaragua dispute, and Great Britain and Nicaragua settled a long-standing controversy in like manner half a dozen years ago. The dispute between Chili and the Argentine Republic, as to frontier boundary, was settled by arbitration about the same time, and the principle is developing as the improved spirit of diplomacy is growing among nations and governments.

One of the latest instances of the growing tendency to settle disputes amicably on the lines of the Protocol No. 23 of the Paris Conference is the appointment of the new Fisheries Commission, which was announced in the House of Commons almost at the end of the Session of 1887. The Commission was charged with the settlement of the disputes between this country, the United States, and Canada.

It should also be mentioned that the London Peace Society, in furtherance of the objects of which we have given an outline, is trying to effect "a permanent Arbitration Treaty between the United States and England." Two hundred members of the House of Commons memorialized the Government of Washington in its favour, and Mr. William Jones, the Secretary of the society, arrived in America in the early part of September, 1887, upon his peaceful mission. He was fortified by a letter from another veteran pioneer in the same cause, Mr. John Bright, who, speaking of the projected treaty, said:—"The project is a reasonable one, and discussion on both sides may bring it about. I think, if the Government of the States were willing, and were in any way to signify their willingness, to become a party to such a treaty, there is a force of good men with us to induce our Government to consent to it. If this can be done, it will be a grand step forward in the world's march, and would be followed, at some not distant time, by some other nations willing to escape from the sore burden of these military armaments. You will doubtless see many intelligent and leading men in the States, and will learn something of their feelings on this matter. They may receive you as a trustworthy representative of the moral and peace-loving people in England, and I hope your interviews may do something in the direction that you and I so greatly desire. I find that nearly 200 members of the House of Commons are addressing a memorial to the Government at Washington to suggest an Arbitration Treaty such as I have described. More, far more I hope, than this number will be ready to urge the acceptance of such a treaty upon our Government if the action at Washington should meet with any favour and success. England and the States will remain two nations, but I would have them always regarded by themselves as one people. An arbitration treaty honestly made and adhered to would tend much to this blessed result."

Who can estimate the lives that have been spared, and the amount of treasure saved the wide world over, by the earnest, self-sacrificing efforts of the noble army of apostles of peace who, in season and out of season, have striven to make their humane principles the adopted guides to international controversy? They have accomplished much, though we are still a long way off the day when strong nations shall beat their "swords into ploughshares, and their spears into pruning hooks," and abandon war for ever.

CHAPTER XVI.

THE MILITARY AMBULANCE SYSTEM.

How far we are from that consummation hinted at, in the foregoing chapter, and imagined and vividly depicted by Wiertz upon one of his canvases in the celebrated gallery at Brussels, when the Angel of Peace shall break the "last cannon"; or from the realization of Pope's ideal of Peace extending her olive wand o'er the world, are problems which the present generation at least is not likely to solve. To-day, when a faint breath of diplomatic discord is sufficient to set Europe and the world on the tiptoe of expectancy of actual conflict, it does indeed appear as though the olive branch of the poet and of the philanthropist were destined to wither in the chill blasts of reality. The suggestions of Grotius, Kant, Stuart-Mill, and hosts of successors, to form an International Tribunal for the settlement of international differences are set at naught upon the least pretence, and forgotten until the record of some new bloody struggle makes the world shudder and wish that it "had not been."

The world still remains faithful to its old traditions. The only difference is that wars may be more quickly terminated than formerly. However, it is said that all mitigations of the laws and usages of war point to the noble ideal of the lovers of mankind—a perpetual peace. One of the greatest of these mitigations is the spirit of humanity to man, encouraged and developed by the Military and Civil Ambulance Systems. One writer on the subject, to whom we subsequently refer, says that ambulance aid, and the good it can bestow upon humanity, remains still almost undeveloped; that though there is a growing spirit of humanity abroad, and an intense desire to lessen as far as possible the bitterness of human suffering, yet there is an ignorance of the method of doing it. In ambulance work he sees one method, whether it be upon the battle-field or in the more peaceful emergencies of life.

It is the ambulance work and equipment under military organization that we shall consider first. The prosecution of the work has been greatly aided by the result of the Conference of Geneva which sat in 1864. The delegates had certainly a good precedent in the Treaty of 1759 between France and Prussia, when so finished a soldier as Frederick the Great recognized the distinction between combatant and non-combatant. The following European Convention was signed on August 22nd, 1864:—(1) The ambulances and military hospitals to be neutral, and protected while they contain sick or wounded men. (2) All persons attached to the hospitals and ambulances to be protected as long as they pursue their avocations; and (3) may even after the occupation of the ground by the enemy continue to perform their functions unmolested. (4) The *matériel* of military hospitals shall be subject to the laws of war, but ambulances under similar circumstances to continue in possession of their *matériel*. (5) Inhabitants of the country assisting the wounded shall be respected and remain free, and be favoured in various ways. (6) Sick and wounded soldiers to be received without distinction of nationality. (7) A red cross flag, corresponding in both camps, to be placed with the national flag over all hospitals and depôts. (8) The execution of the present Convention to be regulated by the Commanders-in-Chief of the belligerent armies. (9) The Protocol to remain open for future adhesions. (10) The Convention to be ratified at Berne within four months.

To Frenchmen, with the approval and assistance of the first Napoleon, is due the initiation of the Ambulance system. Baron Larrey, just before the commencement of the eighteenth century (in 1792), introduced his *ambulances volantes*, or flying field hospitals. These were light carriages capable of moving about from place to place with remarkable expedition. They were like the flying artillery of the time. Adapted not only for affording all that was necessary in the shape of surgical help, they were constructed to remove the wounded with celerity out of reach of the fighting. The troops were delighted with Larrey's conception, consequently it rose in great favour, and was ere long brought to a high condition of perfection. A necessary adjunct to Larrey's transport conveyances was the corps of *brancardiers*, or stretcher-bearers, introduced almost simultaneously by another French army surgeon, Baron Percy. The *brancardiers* were a number of soldiers trained and thoroughly equipped for the duty of collecting the wounded while the battle was in progress, and carrying them on stretchers away from the line of fighting to the stations where Larrey's means of surgical aid and assistance were provided. Conjointly the two systems became necessary auxiliaries in the French army.

Notwithstanding the development in the efficiency of the ambulance service of other countries, who possibly found increased attention to this branch of organization necessary on account of being more frequently pressed with wars, the British army was found in a lamentable state under this as well as under every other head in the Crimea. It was not from want of warning, for the experiences of the Peninsular war, and the subsequent writings of Peninsular surgeons, were enough to have prevented the melancholy exhibition of callous neglect of our wounded. A complete scheme of an ambulance establishment was actually formulated by one of the Peninsular surgeons (Millingen) at the close of that campaign, to avoid in future contests any repetition of the unnecessary suffering; but it was passed over, and ultimately ignored. Thus when the Crimean war broke out we were still without an ambulance corps, or an ambulance establishment of *matériel.* Hastily a corps of military pensioners was raised; but what could enfeebled constitutions and infirmity do in the face of the difficulties to be encountered? A civilian corps was substituted, but the ignorance of its members of military discipline and habits foredoomed it to failure. The sick transport vehicles were likewise inefficient, and not alone was Lord Raglan, after the battle of the Alma, embarrassed for the means of dealing with his poor suffering men—the conveyance of them down to the beach for shipment to the military hospitals at Scutari was a work of delay and misery to all concerned. The same was experienced at Sebastopol, and, in fact, throughout the contest. The French arrangements, on the other hand, were excellent; their ambulances at least were comfortable, and their invalids were transported to the beach with ease and safety.

At last we profited by experience, and after 1856 a trained Army Hospital Corps was founded, and much of the ambulance equipment revised. There was at first one impediment in the way of perfecting such a branch of the service, and that was the costliness of its maintenance in times of peace; but to a great extent this has been overcome by the organization under the existing *régime*, which is very lucidly explained by Surgeon-Major J. G. H. Evatt, who, besides making a very valuable contribution on the subject of Ambulance Organization; Equipment and Transport, to the literature of the International Health Exhibition of 1884, delivered a lecture there, in which he described the rules that now govern military arrangements for the purpose of giving ambulance-aid in war time. An English army corps, he explained, is the largest organized unit of the entire body of the English army, and it consists of 36,000 men, 12,900 horses, and 90 pieces of artillery, besides about 1,400 carts and waggons. That organization is broken up into smaller parts—a first division, a second division, and a third division of infantry; a cavalry brigade and artillery—that is to say, a body of troops, artillery and engineers, which is called the Corps Troops. Those divisions and brigades are again broken up into minor units, consisting of infantry battalions, cavalry regiments, and batteries; and in those divisions there are twelve units—viz., six regiments of infantry, a regiment of cavalry, and four batteries of artillery. There is also a company of engineers. In the division of the corps artillery there are thirty guns, which are divided into five batteries, and there are two companies of sappers and miners. This is an English army corps as it stands in battle array. The ambulance arrangements are governed, and the sick and wounded cared for in this way:—With every battalion, or regiment, or battery is posted a medical officer, who has with him from two to four men per company who are trained in ambulance drill. When a man is shot down in battle, these men are on the spot to immediately attend to him, stop the bleeding, and put on the first rough dressing. The victim is then removed from the range of fire, and comes under the jurisdiction of the Bearer Ambulance Company. These companies consist of about 200 soldiers of the Army Hospital Corps, and eight medical officers, who "form a distinctly new unit in military organization." Owing to the absence of this organization in the Crimean war, Surgeon-Major Evatt points out, great suffering occurred among the troops—in fact, down to the era of the Franco-German war the arrangements in the army for affording aid to the wounded were very defective indeed. The only arrangements which existed were battalion arrangements, or simply the regimental surgeon and his men.

The Bearer Company have in their charge plenty of surgical instruments, all the necessary appliances, cooking apparatus, and plenty of covering; they have their own transport, so that they can move forward with the army, or backward if necessary. With the company the wounded are left; with them they get their wounds first thoroughly dressed; they are fed, and in serious cases are passed back to the field hospitals. In the Crimean campaign, and in fact until within the last few years, we had no proper military field hospitals organized. These hospitals advance at varying distances with the army, leaving a base hospital to which the injured soldier is ultimately sent if he does not recover sufficiently to go again to the front. From the base hospital he is transferred to the regularly fitted hospital ship, and passed on home to Netley, Woolwich, Portsmouth, or one of the other great army hospitals in England.

Such is the Army Ambulance Organization system, which, however, appears to be still very deficient in strength. An examination of the *matériel* of the

Ambulance service, and even that carried by the individual soldiers in war time, affords considerable interest. Every medical officer carries a case of instruments in a pouch worn over the left shoulder. Every battalion and battery has its "Field Companion"—a small portable medicine case containing compressed drugs, restoratives, bandages, and the materials needed in first dressings. What is called the "Surgical Havresac," containing bandages, restoratives, a simple dressing-case, and tourniquets, is a necessary equipment of the Bearer Companies, who also carry water bottles. In Continental armies knapsacks with contents very similar to those of our Field Companion are much used, and special saddle-bags are provided for the cavalry, containing similar *matériel.* Our fighting soldiers, or at any rate a large proportion of them, carry a bandage and some dressing.

In all ambulance aid the stretcher is one great essential, and, as in other details of equipment, Surgeon-Major Evatt gives some interesting particulars of them. The stretcher used in the Crimea consisted of two side-poles kept apart, when open, by two iron rods called traverses, and a canvas sheet for the wounded man to lie upon. When the traverses were unhooked the poles came together, and could be rolled up in the canvas. There were no legs, and consequently, if it were necessary to deposit it, the patient ceased for the time being to have the rest it otherwise afforded. As is the case with nearly every description of appliance connected with the preservation or the saving of human life, so with stretchers—the invention of them has known no bounds. It must suffice to mention that Surgeon-Major Faris was the inventor of the present regulation army stretcher. It is solidly built, and consists of two side-poles of ash, brown canvas bottom, a pillow, two self-locking traverses, which lock under the stretcher and keep it open. There are four wheels of *lignum vitæ*, on which the stretcher rolls into the ambulance waggon, and which act as legs when used as a camp-bedstead, a use to which all army stretchers are liable. To aid the bearer, it has two leather slings, one at either end, which the bearers put over their necks like a milkman's yoke, and so relieve their arms of part of the weight. The dhoolie, a closed-in litter, is a commodious means of carriage, and has formed the staple sick transport in all our Eastern wars. The approved dhoolie is the design of Surgeon-Major Bourke, of the Army Medical Department. In the Affghan campaign the dandy—a cot slung from pole to pole—was used for the same purpose as the stretcher. Wheel-stretchers are included in the military equipment; but, of course, are not so frequently of use as they are for civil purposes, on account of the broken and irregular ground over which battles have to be fought. Good mule equipment has been necessary for our various wars, and pack animals are used to carry medicine panniers, which are contrived so that when opened out they form an operation-table. For the carriage of wounded two different mule equipments are used, viz., cacolets, and the mule litter —the latter a slung couch, carried on either side of a mule, and supports a person at full length. In the last Egyptian war horses were utilized for this purpose; and if cavalry horses were trained, it has been suggested that numerous cacolets and litters should be carried by each regiment. Camel dhoolies are other methods of transport.

Those vehicles which are regularly drawn by horses are the surgery waggons of the Bearer Company, the pharmacy waggon of the Field Hospital, the equipment waggon of the Field Hospital, the kitchen waggon of the Field Hospital, the water-cart of the Bearer Company and Field Hospital, the laundry waggon of the Field Hospital, and the electric light waggon of the Field Hospital.

Railways have played an important ambulance part in the wars of recent years. Baron Larrey was the first to suggest contrivances to be adopted upon railways, and in 1860 Dr. Gwilt, of the Prussian service, invented a system of hammocks; but to the United States belongs the most efficient development of the adaptability of trains for use in time of war.

It is a more difficult matter to separate the voluntary ambulance and hospital assistance afforded to the American army from that which the Establishment itself provides than is the case with any other country, inasmuch as nearly the whole of the assistance of this description in the war for the Union was voluntary. The commencement of the contest found the Union totally unprepared. Since the War of Independence America had turned her thoughts almost exclusively to internal affairs, and in time of peace a force of 12,000 or 15,000 men was found sufficient, and the medical wants of the troops seem to have been satisfactorily provided from the bureau at Washington. It became therefore necessary to create almost out of nothing a sufficient force, with all the usual appendages, and how America accomplished the task may be told as one of the prodigies of a self-governing people. During the early days of the war, the almost total want of physicians, hospital attendants, and all hospital articles, raised terror and confusion, not only in the army, but among the whole people. Voluntary contributions had been employed to equip for the field the 75,000 men for whom the President had first called. If willing and hearty self-sacrifice were shown by those who rushed to arms in the spring of 1861, they were no less to be found in those who remained behind. Within ten days of the President's call, public meetings had been held in nearly every loyal town, and everywhere war funds had been organized by the patriotism of the inhabitants. Contributions had also to be raised for sanitary purposes.

Before the civil war had continued two years, the head of the sanitary department had several times been changed, and yet the arrangements were not adequate. At length a man who, by his energetic character, the practical experience he had collected during his former services with the regular army, and the confidence reposed in him by the Minister of War, seemed to be eminently qualified for the task—assumed the control of this department and carried out the necessary reforms. Under his direction, during the last two years of the war, when upwards of a million combatants were under arms in defence of the Union, the sanitary arrangements of the army were not found wanting. When we consider the enormous number of men placed *hors de combat* in the great battles (at Gettysburg, the wounded alone were reckoned at 30,000), we may form some idea of the scale on which it was necessary to form an adequate system of relief. During the last year of the war the number of army surgeons elected amounted to not less than 500; besides these, 2,000 civil surgeons were employed in the service of the troops in the field and in the hospitals. Every sick or wounded man from the moment he entered the hospital or the battle-field till the day of his recovery ceased to be a member of the active army, and the sanitary corps alone was responsible for him.

At the beginning of the contest the Union did not possess a single large military hospital throughout the land; during the continuance of the war 195 large hospitals alone were erected, offering in all accommodation for 195,000 men. If the arrangement of these hospitals, with their admirable ventilation, their heating apparatus, and their constant supply of fresh water, was worthy of all commendation, the transport system by the railroads and great rivers was no wise inferior. On the eve of battle forty railway waggons stood at certain stations in readiness to start. Each waggon, containing from thirty-five to forty men lying down, was in itself a moveable hospital, supplied with kitchen, provision, pharmacy, and medical attendance, and was so constructed that the motion of the train at full speed might be as little felt as possible. When the transport was by water, steamers were employed, either built expressly or fitted up as hospital ships. According to the official report of the 8th of September, 1863, there died of the army of the United States, during the first year of the war, 67·6 men per thousand. One million and fifty-eight thousand soldiers were stated to have been in the hospitals of the Union during the four years of the contest; of these only eight per cent. had died. Truly no country has equalled America in the care of its own soldiers—a fact which received peculiar emphasis when an Act was passed in March, 1864, entitled "An Act to establish a uniform system of Ambulances in the United States."

The system became naturalized in Germany in 1850, when it was first wholly adopted by Austria. Every company consisted of thirty-two soldiers, who were provided with poles with which two men might form a litter to bear the wounded from the field. About 200 sanitary soldiers, exclusive of officers, would be allotted to a force of 25,000 men. They would be furnished with three or four ambulances and three field hospitals.

Of this corps 180 men would be engaged in the field and in the ambulances, the remainder in the hospitals. Thus in hospitals designed for 500 sick and wounded, there would not be more than twenty sanitary soldiers employed. Compared with this an old Prussian regulation of the year 1753 contrasts favourably, by which one man and one woman were allotted to every ten sick men in hospital. But how would it fare with the soldier on the battle-field? According to the losses in modern warfare, an army of 25,000 men would suffer a diminution in its strength of twelve per cent. Of these 3,000 one-third might be reckoned as killed, and two-thirds as wounded. At the utmost 180 sanitary soldiers were to be relied upon for the service of the 2,000 wounded, who have to be sought in distant parts of the field, and borne under circumstances of the greatest difficulty and danger to the ambulances lying away from the fire. And if the greater part of those in need of immediate assistance could be carried from the field, the ambulances would be far too few in number to contain them. Later Prussian regulations, however, supplied an army corps with three principal, and three light field hospitals, and a company of 120 men was attached to each moveable hospital. Every battalion, division or regiment of cavalry possessed one staff and one assistant-surgeon, and to each company or squadron a hospital assistant was allotted. By a regulation of the 11th of January, 1866, hospital assistants were allowed to retain both the rank and pay of under officers, and had the prospect of becoming hospital inspectors. But although the Prussian sanitary system sufficed for the Schleswig-Holstein campaign of 1864, it fell far short in the subsequent war with Bohemia. In most of the quickly erected hospitals at Königgrätz there was a want of almost everything. Near the battle-field the wounded soldier looked in vain for shelter, and there was nothing like an adequate supply of conveyances. Yet everything on wheels that could be found, or improvised, or spared by the army, was used for transport purposes, and the interior of every house round about that offered a safe shelter had been appropriated by the sanitary service. The roads were crammed with transport waggons, filled with officers and soldiers in every stage of suffering. From the heat and the want of water the wounds soon assumed a terrible character, and surgical aid was everywhere wanting. The scene was indescribable; and yet if the Prussian sanitary arrangements were wanting, those of Austria were far more inefficient. Dr. Julius Naundorff afterwards recorded the events of the campaign with especial reference to this lamentable feature, and his warnings and comments were not lost upon the Prussian army, as was sufficiently evident in the war of 1870. The German army now has companies of bearers, distinguished by a particular uniform, whose duty is to gather the wounded during battles, and to carry them to the dressing and field hospital stations. Each of these bearer columns consists of a military staff of officers for discipline and direction, non-commissioned officers, buglers, and a large number of bearers; a special medical staff, with assistants and dressers; a transport staff of non-commissioned officers and drivers, with a certain number of stretchers, wheeled stretcher supports, sick transport waggons, and store waggons for the carriage and instruments, dressings, and other necessary materials. Separate establishments exist for the field hospitals. In addition, auxiliary sick bearers are provided for service on the occasion of battles, corresponding to that of the British army.

The systems in other European armies are very similar, although experts say that in no country is the ambulance system as perfect as it should be, or as complete and efficient as the principles of humanitarianism demands.

CHAPTER XVII.

THE STORY OF THE RED CROSS.

WITHOUT disparaging the fame of M. Henri Dunant, to whom is undoubtedly due the origination of the noble humane Society of the Red Cross, we owe to the ministering influence of woman the blessings which have relieved the agony of the soldier's wounds, brought peace to his soul while his body was in the midst of carnage, and brightened the last moments of those who during the last thirty years have been sacrificed in war. Florence Nightingale was the first great pioneer who set forth from England and her beautiful home at Embly in Hampshire, in response to the heartrending cry of distress from the East that pierced England's heart soon after the commencement of hostilities with Russia. Our wounded soldiers were huddled together, languishing on their rough beds, destitute of attention, comfort, and of the necessary remedies which an ordinary Sanitary department might have been expected to have had available—" crushed by the cold unfeeling iron heel of Routine, and by the heavy murderous hand of Mismanagement." The scene which M. Dunant witnessed at Solferino a few years later had been previously enacted among the troops whom Florence Nightingale went out to succour. Among the thousands of wounded soldiers, were hundreds who for lack of refreshment were fast yielding to hunger and thirst, and weariness; hundreds whose lives were to be saved by a little water and a morsel of bread, but who cried for either in vain; and hundreds more who, still breathing, awaited the medical aid which was so terribly deficient.

The expedition headed by our heroine consisted of a band of thirty-seven nurses, many of them, like herself, volunteers from the higher ranks of life—ladies accustomed to luxury and ease, yet not unaccustomed to tend the suffering and the dying in the hospitals at home—and including twelve nuns from the Convent at Norwood, under charge of their Superioress, an Irish lady. They started for their destination on Tuesday the 24th of October, 1854, accompanied by the Rev. Mr. Bracebridge, his wife and a courier. On the 5th of November, the dauntless party arrived at Constantinople, and the whole company were soon established in the Barrack Hospital of Scutari. There was another hospital at Scutari, the General Hospital, and both had been given over by the Turks to the English for the accommodation of the sick and wounded. On realizing to-day the state of things which met the little band of ministering angels in this place—the "silver city" on the Bosphorus—as soon as they arrived, we marvel they did not repent their journey on the very threshold of their errand of mercy. The condition of the hospitals was horrible. Neglect, mismanagement and disease had combined to render the scene one of inconceivable hideousness. Fever and cholera were rampant; medical aid was scarce, and food was scarcer. "Out of the four wards committed to my charge," says one of the nurses writing home, "eleven men died in the night, simply from exhaustion, which, humanly speaking, might have been stopped could I have laid my hands upon such nourishment as I know they ought to have had." Bad as Miss Nightingale found the state of things in regard to medicine, medical attendance and food, it was not worse than the arrangements in regard to hospital clothing. But for the supplies provided by the voluntary fund at home, most of the invalids must have been without underclothing, and been condemned to wear the filthy rags which they had brought from the Crimea.

The training Miss Nightingale had received as hospital nurse, and the natural instinct to overcome difficulties with which she was liberally endowed, rapidly effected a revolution in the condition of things. She educed comparative order out of chaos, with little confusion, and at the same time managed to cheer and solace the afflicted ones in both hospitals. She was ubiquitous: at the bedside of the wounded soldier, stanching his wound and soothing his pain, in the laundry, and in the kitchen, she was ever active. For long after her arrival she was the real purveyor of the hospitals, and but for her many a poor fellow must have died. In one of the letters from Mr. Macdonald, who was compelled to return to England from failing health, he says—"Wherever there is disease in its most dangerous form, and the hand of the spoiler distressingly nigh, there is that incomparable woman sure to be seen; her benignant presence is an influence for good and comfort, even amid the struggles of expiring nature. She is a 'ministering angel,' without any exaggeration, in these hospitals; and as her slender form glides quietly along each corridor, every poor fellow's face softens with gratitude at the sight of her. When all the medical officers have retired for the night, and silence and darkness have settled on those miles o prostrate sick, she may be observed alone, with a little lamp in her hand, making her solitary rounds. The popular instinct was not mistaken which, when she set out from England on her mission of mercy, hailed her as a heroine: I trust she may not earn her title to a higher though sadder appellation. No one who has observed her fragile figure, and delicate health, can avoid misgivings lest these should fail. With the heart of a true woman, and the manner of a lady, accomplished and refined beyond most of her sex, she combines a surprising calmness of judgment, and promptitude and decision of character. I confidently assert that, but for Miss Nightingale, the people of England would scarcely, with all their solicitude, have been spared the additional pang of knowing—which they must have done sooner or later—that their soldiers, even in hospital, had found scanty refuge and relief from the unparalleled miseries with which this war has hitherto been attended."

Meantime disease continued its ravages; frost-bite appeared among the men in its most aggravated form, fever raged destructively, and in less than a month swept away no fewer than seven surgeons, leaving eight more and three of the nurses dangerously ill. Eight nurses were despatched to Balaklava, and under all these circumstances it is difficult to speak too highly of the brave and noble-souled woman left to struggle against such mighty odds. "She would speak to one," said a poor fellow writing home at this time, "and nod and smile to many more; but she couldn't do it to all, you know. We lay there by hundreds; but we could kiss her shadow as it fell and lay our heads on the pillow again, content."

Miss Nightingale left Scutari, where most of her work had been accomplished, and arrived in Balaklava to inspect its hospitals on May 4th, 1855. Her capacity for vigorous organization here was interrupted by an attack of Crimean fever, which prostrated her for some time. On recovery she returned to Scutari, and ultimately, after the accomplishment of her mission, to her other home in England—Lea Hurst, Derbyshire—where she arrived on Friday, the 15th of August, 1856.

Florence Nightingale's example found followers in the opponent's camp. The Grand Duchess Helena collected about three hundred ladies from St. Petersburg, who devoted themselves to the care of the sick and wounded, and received the blessings of thousands of Russian soldiers. These ladies formed themselves into a society, which outlived the war, and promoted and maintained numerous civil hospitals. Besides this society, the Widows of Mercy of St. Petersburg and Moscow acted a noble part in the Crimea.

The experiences, as we have said, of the Crimea were repeated when the War of Lombardy broke out in 1859; but balm for the wounded soldiers of the future was to spring from the bloody field of Solferino. The battle lasted fifteen hours, and was fought with terrible fierceness. More than three hundred thousand combatants were engaged on a line of five leagues, and it is related, as the immediate result of that 24th of June, that the killed and wounded in the Austrian and Franco-Sardinian armies comprised three field marshals, nine generals, 1,560 officers, and about 40,000 under-officers and men. Two months afterwards, in the three armies together, 40,000 men succumbed to sickness and defective sanitary arrangements. A Geneva gentleman, moved by the noblest instincts of philanthropy, hastened to the reeking plains of Italy for the purpose of rendering to the wounded what assistance might be in his power. He published, in November, 1862, "Un Souvenir de Solferino," and all who read that terrible chronicle of the horrors of war, shared M. Dunant's enthusiasm in developing the idea there foreshadowed. A public meeting was held in Geneva—the town from which the humanitarian European Convention was destined afterwards to emanate—on the 9th of February, 1863, a date from which may be reckoned the origin of the Red Cross. At this time the official promoters, who were five members of the Société Genevoise d'Utilité Publique, were unaware of the remarkable achievements of the Sanitary Commission of the United States during the War of the Union.

We have already indicated what was the condition of the American army at that period in the matter of Sanitary arrangements. The women in the States, as n England during the Crimean war, were the first to move to supply the needs of medical aid, and the requisites for nursing the wounded in sickness. On each side, at the outbreak of the war, the women connected themselves with the great work of healing and solace. They began their work of mercy by filling churches, schoolrooms, and the large houses of many wealthy persons, with lint scrapers, cutters, folders, and packers of the linen they gave to the use of the wounded. Then they organized themselves, first in New York, into a Woman's Central Association of Relief, which contained the germs of the Sanitary Commission. Like bodies were formed elsewhere, and advice was sought from men of experience. They were advised to ascertain what Government could and would do in the direction to which their work tended, then to work with it, and by their own liberality of gifts and labour supplement its unavoidable shortcomings. The clergyman of New York who was foremost in giving his counsel, the Rev. Doctor Bellows, accompanied by three of the chief physicians of New York—Drs. Van Buren, Harris, and Harsin—went, therefore, in deputation to Washington for conferences with the Secretary of War. They represented not only the Woman's Central Association, but also the Advisory Committee of the Boards of Physicians and Surgeons of the New York Hospitals, and the New York Medical Association for furnishing hospital supplies in aid of the army. The three bodies were all acting harmoniously together in turning to the best account the free gifts from the City and State of New York, designed in aid of the comfort and security of the troops. They petitioned for more rigour in inspection of volunteers, that unsuitable persons might not be sent to certain death in the army; the Woman's Association was about to send for service in the general hospitals of the army one hundred picked and trained female nurses, and they asked that the War Department should be content to receive on wages, during actual duty, as many of such nurses as the exigencies of the campaign might require. They suggested also the appointment of a Sanitary Commission, which President Lincoln scoffed at as "a fifth wheel to the military coach." This memorial was coldly received; but the four delegates sketched out a plan of the Commission they asked for, and after a note in recommendation of the scheme from Dr. R. C. Wood, the acting surgeon-general in the United States Army, reluctant consent was given in a document, of which the last paragraph thus expressed the official contempt it excited: "The Commission will exist until the Secretary of War shall otherwise direct, unless sooner dissolved by its own action."

History, however, offers its tribute to the gigantic Commission which received official recognition in such disparaging terms. Its object and business may be thus briefly summarized :—(1) To collect supplies through its branches all over the country. (2) To found and support soldiers' homes, where shelter, food, and medical care were furnished to disabled soldiers. At one period the eight homes of Washington, Cincinnati, Cairo, Louisville, Nashville, Columbus, Cleveland, and New Orleans are stated to have given food and lodging to 23,000 men every twenty-four hours. There were also several "Lodges" or homes on a smaller scale, where the soldier, enfeebled but not disabled, might obtain rest and medical treatment until he could rejoin his regiment, or from whence, if necessary, he might be transferred to hospital. (3) To keep a hospital directory, by which the whereabouts of disabled men might be ascertained by their friends and relatives. This was corrected every day, and bureaux of information were established in the large towns. To obtain the necessary knowledge, agents of the Commission were to be found in every military camp and hospital. When in full force twenty thousand dollars a year were expended in the maintenance of this branch. (4) To carry out a system of hospital inspection, sixty of the most skilful surgeons and physicians were at one time employed, and 70,000 beds were visited. (5) To find means of transport for sick. The transports of the regular service, as well as the hospitals, were also inspected by the delegates of the Commission. (6) To maintain a regular battle-field service independent of the army sanitary system, homes were established at the chief halting-places on the line of march, where sick or disabled soldiers might find rest and medical attendance.

One of the most difficult labours of the Commission was to induce the multitude of local soldiers' aid societies which had arisen to come in under the wider and more comprehensive organization. One by one, however, the work of woman's love that strove to follow the particular fortunes of brothers and friends, was gathered into the sole great national effort projected to secure the well-being of the army and detect the more unwholesome blots upon its discipline wherever they might be. Associate members were enrolled, and the printing press was set to work to spread a knowledge of the requirements of the army. Sanitary agitation was not allowed to flag, and every imaginable effort was embraced under the Sanitary Commission. Central depôts for districts were arranged; the Commission sent Sanitary inspectors to camps and camp hospitals, and accomplished the reorganization of the Medical Department of the army, with which hitherto the Commission had been somewhat at loggerheads. Dr. W. A. Hammond, who was Assistant Surgeon-General, and who was friendly towards the Commission, was promoted to the post of Surgeon-General, and with its own man in authority, the Sanitary Commission had its way made very straight. Dr. Hammond revised his list of subordinates with a bold hand, got rid of the obstructive and incompetent men, and honestly sought the best help in organization of hospitals, the foundation of an army medical school, and so forth. Before the Civil War, the United States army rivalled the Austrians in exclusiveness and firm adherence to routine; and who can tell what harrowing tales of pestilence and suffering might not have been heard, but for the victory thus won on behalf of woman's work in the time of peril?

The work of this Commission deserves even further recognition. After every great battle it despatched a voluntary contribution of necessaries in addition to the provision made by the Medical Department of the army. Thus, after the second battle of Bull's Run—when

General Pope's army, with a loss of sixteen thousand in killed and wounded, was in retreat—the Confederates captured forty-three waggon loads of drugs and medicines which were at the disposal of the army; and at Centreville, on the road from Bull's Run to Washington, the Commission's agent served out to the wounded, who came fainting in by hundreds, hot beef-tea, soup and bread and stimulants—gathered them into ambulances or hospitals—and otherwise helped them on to Washington. The Commission always extended such help alike to friend or foe, and when, at the battle of Gettysburg, a waggon load of the Commission's stores was captured, with three of its agents, the secretary of the Commission asked for and obtained from the Confederate authorities their release, on the ground that they were non-combatants, and that throughout the war "the Sanitary Commission had never made any distinction in its benevolence between friend and foe." The labourers of the Commission worked under fire in the field relief corps that trolled up their light waggons with stores, bandages, or other aid to the surgeons wherever men fell fastest, and after the battle they hunted indefatigably for the straggling wounded. A distinct department of special relief organized by the Commission was that for the care of the sick among newly-arrived regiments; for providing temporary and gratuitous shelter and food to the soldier honourably discharged, while he was waiting in any city for his papers and his pay; for helping the helpless soldier in every conceivable way, by acting as his unpaid agent or attorney, for protecting him against sharpers, or getting him railway tickets at reduced rates. Finally, the Commission charged itself with the duty of seeing that every soldier was decently buried, with a headstone over his grave.

The fund by which all this was accomplished was, as we have said, voluntary. The people of California sent, in one sum, the gold of their soil to the value of one hundred thousand pounds sterling. Sanitary fairs in different cities produced fabulous sums, notably that of Brooklyn, which contributed four hundred thousand dollars, and that of New York, the proceeds at which exceeded a million dollars. In short, the voluntary contributions from a people oppressed with the terrible expenses of a prolonged campaign, reached the enormous total of over seventy million dollars.

The Geneva Committee, being at the time ignorant of all this, were somewhat perplexed about details, which otherwise might not have caused them any trouble or misgiving. However, they summoned a General Conference, which assembled at Geneva on the 26th of October, 1863, to consider the best means of lessening the evils attendant upon war. The Conference was held under the presidency of General Dufour, and among those present were the King of Holland, the Grand Duke of Baden, and representatives of England, France, Austria, Prussia, Spain, Bavaria, Saxony, the Grand Duchy of Hesse, Hanover, and Sweden. The first meetings did not result in the formation of any volunteer corps for the attendance upon the sick and wounded, nor was any other practical good obtained. But in the following year the Conference re-assembled under more favourable auspices. The circular of invitation, dated June 6th, 1864, was issued from the French Government in particular. It was addressed by the Conseil Fédéral to no less than forty States. From Turkey, Greece, and Mexico answers were received before the final sitting, expressing regret that they could not this time participate in the Conference. The German Bund displayed its usual want of promptitude; no answers were received from Hanover and Brazil; while Austria, Bavaria, and the Papal States made no secret of their disinclination to take any part in the proceedings. The representative of Russia arrived too late; four other States—Great Britain, America, Saxony, and Sweden—sent representatives, but without investing them with necessary powers, reserving to themselves the right of joining at a later period any Convention that might be framed. The formation of volunteer sanitary corps was not this time discussed. It was assumed that they would generally be welcome wherever they appeared; but it seems also to have been understood that several of the greater military Powers would have declined to give their adhesion, had the institution of such corps formed one of the stipulations. Finally, the Convention, an abstract of which is given in the preceding chapter, was signed, and thus we have the proclamation of the absolute neutrality of the wounded soldier and of the Sanitary Department; not for the first time in history though, as we noted in the last chapter in the case of the Franco-Prussian Treaty of 1759, and, much more recently, in the American War of Secession. Moreover, there is a Society which claims to have exercised the general principles of neutrality long before the plenipotentiaries met at Geneva, viz., the Prussian Order of St. John of Jerusalem, the foremost and most ancient of the voluntary societies of Europe for the relief of the sick and wounded.

Red Cross Societies exist now all over Europe, and beyond it, although they do not enjoy official international recognition. The central committee at Geneva has no official status. Nevertheless, the organizations have achieved a great deal; they have supplied for the sick and wounded a very large amount of assistance, both in *personnel* and *matériel*. They have been the great, and in many instances the only, channel for the flow of spontaneous charity, which, to a very great extent, has stimulated the medical services of armies themselves. Surgeon-Major Evatt sets forth the outline of the organization as follows :—“ At Geneva there is an International Committee keeping up communication with all the National Societies, and publishing a paper quarterly as a circulating agent between the different countries. In each country there is but a single Red Cross Committee representing the whole national organization. In some countries there is distinct official connection between the societies and the military authorities, in others this is not the case. Money is collected, ambulance provided, and nurses collected and trained, and the agents of the Red Cross, during each campaign, hasten to the scene of action, and endeavour to give what aid they can by money, men, and advice.”

The modern Protestant Society of the Knights of St. John of Jerusalem, although adopting, in common with the Red Cross Society, the sign of the red cross on a white ground, is not allied to the latter. It took its rise in Germany during the so-called religious wars, and in the Danish campaign of twenty years ago won its laurels. Hospitals well supplied with civil surgeons and attendants were erected out of the funds of the Order in Altona and Flensburg, and field hospitals in Nübel and Western Satrap. Large contributions in money flowed into their treasury, whilst medicines, food, and every article of which they stood in need were sent from the farthest ends of Germany. But the knights were not wholly dependent upon these contributions, because they devote themselves in peace to collect what may be necessary for their next campaign — a circumstance which accounted for their efficiency in the conflict of seventeen years ago. On the battle-fields in 1870 the knights were everywhere to be found, regardless of the fire around them, exercising with devotion the duties of their office towards friend and foe. The Maltese Knightly Order of Germany is the Roman Catholic division of the same Order; and, with regard to other foreign Orders, Surgeon-Major Evatt gives a list in his Health Exhibition Handbook. From it we gather that an Austrian Order —the Deutsche Ritter—has long been in the field, from mediæval times and before the Red Cross movement. It has a distinct agreement with the State as to its duties, its ambulance waggons, and its *matériel.* It divides its war-work in a definite manner with the Austrian Red Cross Society. A wealthy military Order furnishes complete trains of railway ambulance, transport, and field *matériel,* providing also surgeons and attendants, whilst the knights themselves also take the field. Dr. Baron Mundy had the organization of its railway ambulance trains, which are the most complete in Europe. In Italy and Spain the Knights of St. John are active, working in the latter case in conjunction with the Red Cross Society of Spain. The president of the International Committee at Geneva is Gustave Moynier, whose history of "The Red Cross" has been translated into English by Mr. John Furley; and there is a Central German Committee at Berlin, while there are allied societies in England, America, France, Italy, Belgium, Baden, Bavaria, Russia, Greece, Holland, Saxony, Switzerland, &c.

At the time of the war of 1864, in the Elbe Duchies, the Red Cross Society had not been thoroughly organized, the Conference of Geneva had hardly closed, and the Prussian and the Wurtemburg Societies were the only associations emanating from the Conference which were at all in the position to go into the battle-field. Nevertheless, much zeal and devotion were shown on behalf of the wounded, and the efforts were only the forerunners of more remarkable work in wars to come. The war of 1866 in Austria, Italy and Germany found the societies much better prepared, although, owing to there being no amalgamation of provincial committees, the organizations could not put forth their fullest power. Germany was the most conspicuous for the adequacy of its societies, towards which money was lavishly subscribed. The arrangements were as perfect as those we have described as existing in America a year or two earlier. In Berlin and the provinces buildings were appropriated for the reception of heterogeneous stores, and at one time no fewer than two hundred paid employés, assisted by volunteers and two hundred and fifty ladies, acted as sorters and packers at the Central Depôt. The railways carried the material anywhere according to requirements, and it is on record that one train, composed of twenty-six waggons, carried one hundred tons of articles, valued at £12,000. Refreshment stations were established on the passage of the convoys of wounded. At the station of Pardubitz, which was one of the most frequented, from six to eight hundred men were fed and had their wounds dressed daily during two whole months, and as many as three hundred found a lodging there each night. In spite of the ravages of cholera, and the consequent complication of the work, the Committees struggled bravely and successfully to accomplish the objects of their organization, and they were enabled to do this by the flow of charity which had never before been so abundant in any European conflict.

The great war of 1870–71 was, however, the occasion upon which the Red Cross was to justify its existence. M. Moynier points out that at this time the societies were in a better position than before to meet "acts of violence with those of charity." Besides, among other circumstances which had contributed to their development and increased efficiency, the Great Exhibition at Paris, and the two International Conferences at Paris and Berlin, had considerably aided in this direction. The first at which the Red Cross had displayed its material had aroused the ingenuity of inventors, while the Conference had established close relations between the different committees. Germany in this campaign was better organized than ever. At the very first signal of war more than 2,000 committees arose at all points of the country, and their network covered the land in all directions. Again the wave of generosity brought myriads of necessary articles, from camp furniture to tobacco, and boundless wealth to scatter broadcast in the noble work of the Red Cross. The receipts of the Central German Committee alone amounted to £2,800,000. Notwithstanding the very elaborate organization for the relief of the sick and wounded, both of the armies of the Red Cross and kindred societies, including the National Aid Society in London, yet it fell short of perfection. The terrible carnage of Wörth and Forbach strewed the ground with myriads, and at Sulz the wounded remained for three days absolutely deserted on the battle-field, and exposed to cold and hunger. There was no fault in this as was the case in the Crimea—it was an unparalleled disaster, with which even a hitherto unexampled voluntary effort fell short of dealing. There were hundreds at Saarbrück lying with shattered bones upon the roughest and hardest of straw mattresses, mere bags stuffed with straw and hastily made. A thousand pounds from the London Society to the late Dr.

Humphry Sandwith, who was on the spot, replaced these mattresses with comfortable beds. "Imagine," wrote the English emissary, "if you can, how much attendance you would require if, like poor Hans Wolf, a ball had shattered the fingers of your right hand, and had passed through your left forearm! and there are several cases like his. The Sisters of Charity, God bless them! are indefatigable; but there are not enough of them. But what a sweet and blessed sight it is to see these gentle beings diligently tending the poor mutilated men lying in ghastly rows in these long corridors! See with what a delicate touch that sweet Sister cleanses the intensely irritable stump of the poor fellow whose leg was amputated ten days ago! His countenance is full of anxiety; the least pressure on a certain corner is agony; the dropping of water even is irritating. Well, at last the dressing is over, and he breathes freely, and forgets not to thank the dear Sister; but his eyes are more eloquent than his tongue; he looks his thanks and kisses her hand, ere she leaves him, with childlike affection."

France, on the other hand, was in a lamentably deficient state of organization, so far as its Red Cross Societies were concerned, when the war broke out. Although founded in 1864, the French Society had neither *personnel*, *matériel*, nor money; but, with an abundance of resource, the Paris Committee surmounted its difficulties, aided by a generous flow of charitable help. Seventeen field ambulances were equipped in a month, and were sent to Sedan; in Paris, fixed ambulances were established in the railway stations to receive the wounded from the battle-fields. The approach of the siege of Paris perplexed the Committee, but they were equal to emergencies, and after the armistice was signed they removed and tended 19,000 of their wounded soldiers.

In this war the neutral aid societies who took an active part under the Red Cross were—England, who alone disbursed £300,000, and sent 1,200 cases of stores; Luxemburg, Norway, Russia, Austria, the Netherlands, Italy, Spain and Portugal, Belgium, Sweden, and Switzerland.

During the twenty months' contest between the Slav and Turk, in 1876–8, the responsibility of affording relief was forced on five different societies, viz., those of Servia, Montenegro, Roumania, Russia and Turkey, aided from the societies of neutral countries. In connection with the latter assistance, and the help from London, M. Moynier writes:—"The scruples which retarded the action of central committees, during the first period of the war, in no degree checked that of London. It came to an understanding with the Committee of the Order of St. John of Jerusalem, and hastened to show itself on the theatre of the Turko-Servian war. In an incredibly short space of time, it established a hospital of one hundred and fifty beds at Belgrade, it despatched field ambulances to the Servian army, and provided carriages and a floating hospital for the conveyance of the wounded. On the Turkish side, we find it at Nisch, Sofia, and Scutari in Albania, directing hospitals which it had created there; at the head-quarters at Alexinatz, it was represented by an ambulance, where the doctors initiated their Ottoman *confrères* in the use of chloroform, and it was to be found wherever suffering was apparent. At the close of the year 1876 it had spent 270,000 francs (£10,800), and hardly then anticipated that fresh troubles would soon put its energy to new proofs. When Russia marched against its old enemy, the English at once came to the front and forwarded relief on relief to the East. They began by freighting a steam vessel, which was despatched to the Black Sea with a cargo of hospital necessaries, valued at 175,000 francs (£7,000), accompanied by five surgeons. Turks and Russians received their share of this help, which in its application assumed various forms. When the vessel had discharged the cargo it was devoted to hospital work, and to the transport of the wounded, the material which was not required for immediate use having been stored in two depôts at Constantinople and Varna; flying hospitals circulated in Europe and in Asia, aid was distributed in Roumania and Montenegro, and hospitals also in full work were to be found at many points on the Danube and the Black Sea. It would have been difficult for foreigners to do more, and we can only admire the generosity, the energy, and the administrative ability which the English Red Cross Society displayed during the sad period."

Before leaving the warlike history of the Red Cross to trace its progress and record its work in the "piping times of peace," it should be stated that the National Aid societies have frequently realized the duty of facing enemies more or less savage and barbarous, who, as M. Moynier remarks, "might not regard the law of nations in the same manner as the Geneva Convention does." The Russian Red Cross had made several incursions towards the East. In 1873 it accompanied the Expeditionary Corps against Khiva, and at the end of 1880 it penetrated the country of Akhals-Tékkés, on the confines of Persia. In Malay, at the other extremity of Asia, the Dutch in 1873 displayed an activity equal to that of the Russians in Turkestan. England of late years has had conflicts in Asia and in Africa; but her Red Cross Society has not done anything very remarkable there. It was absent from the Ashantee war in 1873, and also from the battle-fields of Afghanistan in 1878 and 1879. In the latter year, however, it appeared in Natal on the occasion of the expedition against the Zulus. On the other hand, in 1880 and 1881, during the hostilities against the Boers in the Transvaal, and against the Basutos, it was inactive. The Dutch was the only Red Cross Society which took the field at this time. The Red Cross Society of France accompanied the French expeditions to the south of Algeria and Tunis in 1881, and a final incident mentioned in Moynier's book is one which occurred during the war of 1879–81 in South America between Chili on the one side and Bolivia and Peru, where a National Association represented the Red Cross, and that only came into existence after the struggle commenced, and it disappeared from the scene before the critical moment when Lima was captured.

When we turn to the "civil or peace ambulance arrangements," we have again to yield the palm to the New World for superiority and efficiency of system. It is remarkable, yet characteristic withal, that when America was aroused to her deficiency at the commencement of the civil war, she remedied the deficiency immediately, and, when the war was over, elaborated and perfected her ambulance system in the great cities and towns of her vast continent. The contrast between America and at least two European countries is peculiar. The system originated in France in the Napoleonic wars, yet when their most critical conflict came they were totally unprepared to render the humane services which civilization dictates. England had had ample experience of her own shortcomings in this respect in the Peninsular war, yet was found in the Crimea wanting in the simplest auxiliaries of aid and succour for the wounded heroes of her battle-fields. Neither France nor England, nor in fact any European country, has adopted officially any ambulance scheme adequate to the every-day occurrences in the streets of the large towns. There are municipal ambulances, certainly, for the transport of infectious cases from their homes to the small-pox and fever hospitals; but where are the ambulance carriages and other appliances for use in cases of street accidents, drunkenness, apoplectic seizures, and the hosts of other sudden ills that flesh is heir to?

To the St. John Ambulance Association, which is an offshoot of the Order of St. John of Jerusalem, is due the highest meed of praise for endeavouring to remedy our defects. The Association during the last few years has done much to popularize ambulance work and first aid to the injured by the classes it has organized in all parts of the country, and the machinery it has distributed.

In London an ambulance service is at work provided by voluntary contributions, and its sick transport carriages, hand ambulances, and other appliances are placed in public positions, and are available for the emergencies to which we have alluded; but in the localities where they are most needed—in the mining and manufacturing districts—such organizations are few and far between.

There is an abundance of apparatus, and all that is needed to make this branch of life-saving as complete in all its parts as some others with which we have dealt, is to bring the work within the recognized *régime* of central municipal authorities, and make voluntary aid supplementary, instead of the Alpha and Omega to efforts which are being more and more recognized as belonging to the category of duty, rather than of charity.

CHAPTER XVIII.

WEAPONS OF PERSONAL SAFETY.

THE science of weapons has always advanced. Early in history, rough flakes of stone were used for tools and weapons; later arms and instruments were composed of copper, perhaps hardened with tin, and the Jews appear to have had swords, daggers, spears, javelins, bows, arrows, and slings. Axes or maces were also used by them as weapons of war. Herodotus describes the weapons used by most of the different nations which formed the great army of Xerxes, and amongst these the Medes and Persians had short spears, bows, arrows made of reeds, and daggers. The Assyrians, besides spears and daggers, had wooden clubs knotted with iron; the Bactrians and Parthians bows made of reeds, and short spears; the Arabians had bows, large, flexible and curved at the ends; the Ethiopians bows made from the spath of the palm, four cubits, or six feet long; their arrows were short, and pointed with sharp stones instead of iron; they had spears headed with the sharp horns of the dorcas, and knotted clubs. The spears of the Libyans were hardened at the end by fire. The Paphlagonians, Phrygians, and Thracians had spears, javelins, and daggers. In the Persian army we find they had chariots armed with scythes; and although it is not to the present purpose to go into the history of all the weapons of warfare, yet, as in the earliest times the weapons of personal defence formed the aggregate arms in war, it is not inappropriate to make allusions to some of them.

There was no very wide field for ingenuity in connection with clubs and similar weapons, consequently among nations very far removed from each other there was no great variety. In the matter of knives, swords, and daggers, however, every species and form have been tried, and had their term of popularity. Great care and skill have been employed in the construction of the blades of swords and daggers, many men having obtained fortune and eminence merely in consequence of some minute advantage to which they had attained in the formation of these weapons. At that period of our history when men cased themselves in armour it was of paramount importance that swords should be made of better stuff than the corkscrew bayonets of recent War Office renown; besides, efficiency was promoted by the rivalry that existed between the armourer on the one hand and the sword maker on the other. The sword is an old and favourite weapon. The first swords were glaives and falchions of brass, and to these succeeded the broad curved scimitar of Asia, and the short, straight, double-edged sword with which the Romans conquered the world. The latter weapon, called a Spanish blade, and forged at Toledo, was long the national weapon of Castile. Our riflemen bore a weapon nearly similar. While the East adhered to crooked blades, to those wonderful Damascus sabres that were said to cut metal like cloth, to the tulwars of India, and the scimitar of the Saracens, the West ran into the opposite extreme, and for centuries the long straight two-handed sword was in fashion. Some of these tremendous blades, which were used on horseback and on foot, were five feet long, not reckoning the handle. They could not be unsheathed without pulling the sword over the shoulder, and weighed above twenty pounds. The Tyrolese mountaineers used them against the French and Bavarians in Hofer's struggle against Napoleon, and some of the Highlanders in 1715 still retained the true claymore, which always required two hands. Then came the age of short weapons, of walking-stick rapiers, of small swords, court swords, and other mere toys, whilst about the end of the last century the cavalry of the British army were armed with a scimitar, curved like a hoop, and incapable of giving "point" under any circumstances. The French invented the sword bayonet; we followed suit, with the result that our swords are well enough shaped, although under recent experience they have shown a tendency to "double up."

Spears, javelins, and assegais are weapons of personal safety as well as of offensive warfare in certain countries, and the general construction of them is the same. To an iron, bone, or hardwood end, there is attached a haft of light, straight wood, the two being tightly bound together, the iron or bone being usually let in to the wood. The heavy end barely exceeds one-fourth of the whole length of the weapon, which amounts to about six or seven feet. The Kaffirs on the frontier of the Cape Colony are the most expert in the throwing of the assegai—a weapon constructed as follows: A straight piece of stick about five feet long and half an inch thick at the butt end is selected, and rounded with a knife; a piece of iron about two feet long is then welded into the shape of a spearhead, and the end that is to enter the wood is heated to a red heat, and in this state is allowed to burn into the wooden haft, or handle; thus it enters the wood without splitting it, a condition difficult to obtain by any other means. In order to secure the iron and wood more firmly together the

Kaffir procures the sinews of a freshly-killed animal, and whilst these are wet he wraps them and fastens them tightly round the wood, over the part in which the iron has been burned, then when these sinews become dry, they contract, and thus hold firmly the wood and iron. Another and a very ingenious plan for keeping the wood and iron together is to take a piece of skin, of about four or five inches, from the tail of a calf. The skin is taken off so that it remains in the shape of a small tube, which is slipped over the small wooden end of the assegai and worked up until it encases that part of the handle in which is the iron. The most skilful among the tribes can throw an assegai nearly one hundred yards, and, as we have been made painfully conscious during our Zulu experiences, they are almost certain to transfix their objects at forty or fifty yards. Some of the spear-throwing savages have adopted a plan by means of which they can obtain an additional range to their spears—they have, in fact, adopted the sling principle, which increases their range by one-half.

But one of the most ingenious and original of savage weapons is the boomerang, used by the Australian native. It is formed of very hard wood, and is somewhat in the shape of an arm bent nearly at right angles. It is flattish, and sharper at one edge than the other. The Australian, it is said, forms his boomerang in the rough by placing his heels together and turning his toes out, so that his feet are at right angles to each other; he then traces out the two sides of a square from toe to toe, and this gives the rough outline for his weapon, the great peculiarity of which is that if it misses the object aimed at, it will, when skilfully thrown, return through the air to the place from whence it was cast, and thus re-supply its owner with his weapon. It is said that the boomerang inflicts most serious wounds, and that even large animals are overcome by its force. The blow-pipe is another highly-developed weapon in savage countries. It resembles the pea-shooter, is twelve or fourteen feet in length, and from it poisoned arrows are blown to a distance of a hundred yards. The most celebrated of the tribes among whom the use of this weapon prevailed were those in the northern portion of South America, and they long preferred their native weapon to the rough guns which, earlier than other tribes, they might have procured from civilized traders. The blow-pipe, or tube, is made out of a reed of singular growth indigenous to the country. The reed is carefully inserted within a bamboo tube, and the pith is pushed out, leaving a perfectly smooth passage for the arrows, which are about the size of a lady's knitting-needle. Some wild cotton is fastened to the end of the arrow, and the poison, a thick and glutinous substance, is laid on at the point. A strong pair of lungs and some skill are requisite to send the arrow with its full force; but even a weak person would be astonished at the force with which his arrow is propelled by a slight puff of breath. Poisoned arrows were most common in those countries where poisonous snakes abounded, a circumstance leading to the surmise that as the savage derived some of his poison from the poison bags of the venomous snakes, the idea of using poison occurred to him in consequence of observing the effect produced upon animals by the bite of a snake.

Throughout the world almost every nation either uses or has used the bow and arrow, and no country in the world was formerly more famed than England for producing skilful bowmen. The catapult and balista were to bows, arrows, and slings what our heaviest guns are to the rifles; they were the heavy artillery of the period—ponderous machines, requiring enormous power to move them. The introduction of gunpowder revolutionized not only the weapons of war, but entirely changed the character of the defensive weapons necessary on occasion for self-protection and defence, in various parts of the world. The most prominent of the personal weapons was the pistol, which, improved into the revolver, now occupies the pre-eminent position. According to Sir James Turner, the pistol was invented at Pistoja in Tuscany, by Camillo Vitelli. The German cavalry gave such an ascendency to the pistol as to occasion in France, and subsequently in England, the disuse of lances. In the time of Henry II. the horsemen who were armed with pistols were called pistoliers, and Mary, Queen of England, issued regulations about the same time, and of a similar character to the ordinance of Henry II. of France, with respect to the weapon. But the gradual improvement of the invention, from the ponderous hand-gun to the instrument of more convenient size, brought it into general use, apart from military expediency. The "revolving" addition to the weapon followed; and though it was very imperfect and dangerous to the user, yet it was not until comparatively recent times that anything like safety in its use and efficiency in the results were achieved. This was accomplished by Colonel Colt, who, living in the United States, recognized the peculiar want of efficient arms in a country whose inhabitants were constantly moving onward towards new settlements, where the pioneers were required to protect themselves and families by their personal prowess, frequently against fearful inequality of numbers, from the attacks of the aboriginal Indians, whose mode of warfare could only be coped with by rapid and repeated firing. Thus the Colonel was led to try his skill in the production of a kind of gun or pistol which could be fired rapidly many times in succession. He was but partially acquainted with what had been done in Europe, and he spent much time in trying plans which had already been found in the Old World to be valueless. At length he produced his celebrated revolver. The general principle of the invention can readily be understood. In a double-barrelled, or a four-barrelled, or a six-barrelled pistol there were formerly two, or four, or six barrels, each bullet having a barrel to itself; but in the revolver there is only one barrel, through which all the bullets pass in rapid succession. There is a revolving cylinder, with six chambers or receptacles, each of which is brought by the revolution successively in a right line with the barrel. The rotating of the cylinder is effected by a self-acting lever, to which motion is given by the act of drawing back the trigger. Each little chamber is separately loaded, and when all are loaded the weapon is ready for firing. Each chamber, when its charge is fired, being in a right line with the barrel, the bullet passes through the latter as in an ordinary pistol, and the cylinder then traverses one-sixth of a circle to attain the requisite position for firing another chamber. In September, 1850, the American Senate passed a resolution requesting the Secretary at War to obtain the opinion of officers in the army concerning the weapon ; the secretary appointed a committee, and this committee published a report. It appears there were four kinds of revolving pistols in America by four different inventors, but nearly all the officers awarded the palm of superiority to Colt's.

It was about the year 1840 that Colonel Colt surmounted the difficulties of his task, and produced an efficient weapon, which gradually came into use in the United States army—first by the Mexican ranger troops, and then by the mounted riflemen. The value of the revolver was demonstrated in the hand-to-hand conflicts which were of frequent occurrence on the Texan frontier with the Prairie Indians. "Those prairie tribes ride with boldness and wonderful skill, and are perhaps unsurpassed as irregular cavalry. They are so dexterous in the use of the bow that a single Indian at full speed is capable of keeping an arrow constantly in the air between himself and the enemy. Therefore, to encounter such an expert antagonist with any certainty of doing execution, requires an impetuous charge, skilful horsemanship, and a rapid discharge of shots, such as can only be delivered with Colt's six-shooters. They are the only weapons which have enabled the experienced frontier man to defeat the mountain Indian in his own peculiar mode of warfare; in those encounters, which, though soon over, require a steady nerve, the greatest possible precision and celerity of movement, there is no time to reload firearms, even were it possible to do so, and manage your horse in the midst of a quick and wily enemy, ever on the watch, and ready to lance the first man who may lose the least control of his animal." Colonel Colt manufactured his invention, and sent a collection to the Great Exhibition in 1851. They at once attracted the attention of English military men; for, although our shooters had before known something of revolvers, the American had unquestionably the merit of establishing the invention on a firm basis. After the Exhibition was over, Colonel Colt established a manufactory in London, and maintained the marvellous reputation his ingenuity achieved him. There have, of course, been numerous improvements since the original Colt's revolver, and there are legions of different classes of the weapon in use, the latest being a diminutive instrument of terrible power, which can be grasped wholly within the hand so as to be out of sight, and yet fired by the inward pressure of the thumb joint. The revolver adopted in the English army was Adams's, which exceeded in efficiency all previous inventions.

In weapons which may be regarded as of a more domestic character are life-preservers, the shilelagh, burglar-alarms, locks, bolts, bars, &c., all of which have no small position among the numerous contrivances to protect the safety of person and property. The life-preservers are familiar instruments, at all events in the police force, and they have stood the test of experience very well, although it is not at all unlikely that an additional arm of self-defence in the shape of the revolver will ultimately be conceded to a class of men whose lives, particularly in large cities, are jeopardized more than those of any other section of civilians. Burglar-alarms have been patented galore, and range from the simple detonating explosive cap, which can be affixed with slight difficulty to doors and windows on retiring for the night, to the elaborate system invented by Dr. Taussig of Prague in 1887. This system, as a whole, serves the purpose of giving fire alarms, as well as warning of burglaries. In the scheme there are in different parts of a given area central stations covering the defined district. The residences, offices, warehouses, or shops of such persons who pay an annual subscription are fitted up with a transmitting instrument placed in electrical communication with the central station of their district. So far the arrangements are similar to that between the telephone companies and their subscribers, although the object to be achieved is very different. The attendants at the receiving stations do not place the subscriber signalling to them in communication with any other subscriber, but at once signal to the police or fire-engine station, as the case requires, nearest to the establishment from which the signal or message has been received. Nor is it necessary for the subscriber himself to signal, for, if absent, the fire or the burglar indicates both their presence and locality, because the transmitting apparatus is also automatic. All that is necessary in this case is for the subscriber to switch on his apparatus to the main line when he leaves his house or place of business, and to switch it off when he returns. In the case of a residence the apparatus may always remain switched on, so that should a robber effect an entrance either by night or day the fact would be instantly communicated. The transmitting apparatus is contained in a case about two feet high, one foot wide, and six inches deep, and is connected with a small battery, and the main wire to the central station. The upper half of the case contains the automatic apparatus, which consists of a clockwork arrangement, and an electro-magnet. A weight is suspended from the clockwork mechanism, and hangs in the lower half of the case, and after a given number of signals have been transmitted, this weight, which has now run down, presses a button, which causes a bell to ring. This indicates that the clockwork must be wound up before any more automatic signals can be given, and the bell remains ringing until the apparatus has been wound up. In the lower part of the case is also a Morse key and telephone, thus affording two more means of communication, the whole three being capable of being worked on one wire. This apparatus is attachable to the main entrance door, or any other door, window, or place desired. Some credit, perhaps, should be given to the burglar for acuteness in knowing that he is dealing with electricity, and that if he severs the wires he will remain undetected. He would, however, find himself mistaken, for, on cutting the wires, he would at once announce his presence to those on duty at the central station. At this latter is a signal bell and a Morse recorder, on the riband of which is a printed message sent by the transmitter indicating the nature of the call and the house from which it proceeds. The system was first adopted in Prague, Vienna, and Gratz, where its success induced its more extensive adoption in other parts of Europe.

With regard to the subject of locks and bolts, it is impossible to enumerate the wonderful and minute inventions of some of the leading lock manufacturers; although, as a matter of fact, Edgar Allan Poe's theory, that no human contrivance could baffle human ingenuity, is borne out, to a certain extent, in the history of lock-making and lock-picking. No sooner had a lock appeared guaranteed to defy the picker than some one came forward and picked it; and of those who so came forward perhaps the most accomplished was Mr. Hobbs, the relation of one or two of whose exploits will add romance to the subject. Mr. Hobbs came to London as an exhibitor, to the Great Exhibition. He had crossed the "herring pond" at a time when the favourite lock was the letter lock, which had arrived at such a state of perfection that complete reliance was placed upon it. Forward, however, came Mr. Hobbs, with the declaration that not a lock had yet been made in England that could not be easily picked. In consequence of this challenge he was invited to visit a lock factory, where one of the infallible letter locks was put into his hands, and while "its advantages were being descanted on—its entire independence of a key or other separate instrument—the length of time it would take to put it through its millions of permutations—and the consequent utter impossibility of getting it open by any illegitimate means short of wrenching or sawing its parts asunder, Mr. Hobbs was turning the instrument about in an apparently unconcerned manner, with his fingers, and in a few minutes from the time he first had possession of it, to the great amazement and consternation of those who were sounding its praises, he showed them the lock open in his hand. If a miracle had happened they could not have been more astonished." The almost universal faith in the letter lock was thus shaken, whereupon the tumbler lock (Chubb's patent) supplanted it. The ingenious American lock-picker said he would pick a Chubb's lock on the door of a strong room in the City, and in presence of Messrs. Chubb. He accomplished the task he set himself in twenty-five minutes, and locked it again in seven.

In Piccadilly there had been hanging in a shop window for some time a padlock, and over it a notice offering a reward to any one who would make an instrument to pick it. Mr. Hobbs undertook to open the lock, and a formal agreement was entered into between him and Messrs. Bramah, the proprietors. The lock was to be enclosed between two pieces of wood, and secured to a wall so that the key-hole and the hasps should be accessible; the true key was to be sealed up until the operator had either picked the lock or given up his task. When not at work Mr. Hobbs was to cover the keyhole with an iron band secured by himself. He was allowed thirty days. Mr. George Rennie, Professor Cowper, and Dr. Black were the arbitrators. After fifty-one hours' work, spread over sixteen days, the

American accomplished his object, and shot the bolt of the lock backwards and forwards in the presence of the arbitrators, thus having won the reward of two hundred guineas. He was beaten, nevertheless, by the patent of Mr. Cotterill, of Birmingham, who challenged him to open it. He undertook to do it in twenty-four hours, but gave it up at the end of twelve, and acknowledged, when he afterwards examined the inside of the lock, that "A man might work at it a lifetime and not overcome it." This was the first demonstration that locks could be made which it is impossible to pick, and which may fairly be received as absolutely burglar-proof. Locks can be picked, whenever the parts of them which come in contact with the key are affected by any pressure applied to the bolt, or to that portion of the lock by which the bolt is withdrawn, in such manner as to indicate the points of resistance to the withdrawal of the bolt. The knowledge of this has naturally led to the remarkable complications of locks, bolts, and bars of recent years, which have rendered the art of the locksmith one of the most efficient in combating the efforts of those whose profession it is to learn and adopt every device to acquire other people's property, and who do not hesitate to take human life in their endeavours.

What have been called the natural defences of man —his fists—are not in the present day the effective weapons they used to be in the days of what, to be technical, we must denominate the P.R. Boxing should certainly be a part of the curriculum of a boy's education, because the exercise of the "arms" of self-preservation with which nature has endowed us, would doubtless have a tendency to mitigate the dangers consequent upon the too impetuous use of invented instruments more deadly and inhuman, the results of which have to be regretted when remedy is out of reach.

PART V.

MEN IN PERIL AND WEAKNESS

MEN IN PERIL AND WEAKNESS.

CHAPTER XIX.

GREAT EPIDEMICS, AND HOW THEY HAVE BEEN MET.

To the noble army of workers who have made the preservation of life their study and profession, from Hippocrates downwards, we can only make incidental allusion in these pages. The science of medicine has a long, illustrious, and complicated history, presenting a steady record of progress and development, and affording many examples of striking individual achievements. It is necessary, however, that we should restrict our survey of the subject to its broader and more general aspects, leaving matters of special detail and discovery to those who deal with them with technical purpose and method. Particular diseases have their particular remedies, though the remedies of to-day are not the remedies of the past. Time was when the art of medicine was an odd mingling of superstition and error, theory and metaphysics. Indeed, until the fifteenth century the practice of medicine rested in the hands of the clergy to a great extent, and the only medical work of any consequence was Kymer's "Dietary for the Preservation of Health," in which the familiar recommendations touching exercise, the bath, and diet, handed down from Aristotle, are the only principles set forth. But as years went on, and the teaching of experiment came to be valued more than theories and dissertations, great strides were made in medical knowledge. The philosophy of Bacon's "Novum Organum," the discoveries of Harvey, and the general adoption of new ideas, and the weeding out of ancient prejudice, cleared the way for the growth of a purer scientific practice, and bore fruit in more recent times in the eminent contributions to medical science with which the names of Jenner, Simpson, Pasteur and others are associated. These things belong to the records of medicine and surgery, but, important as their bearing is upon the question of life-preservation, and much as they have conduced to the lessening of the dangers of disease, we must not linger over them. Our present concern is with the wonderful, yet gradual, revolution which the last few centuries have effected in the science of sanitation, by which the ordinary conditions of existence have been greatly improved, and the liability to epidemic visitations has been materially reduced.

The "good old times" were more picturesque than healthy, more rude than comfortable. Pleasant enough (in pictures) are the narrow streets of gloomy houses in which our town ancestors of the fifteenth and sixteenth centuries lived, but "the healthy breath of morn" must have had considerable difficulty in getting into them. Pretty enough, too, from the artist's point of view, are the heavy architectural outlines, the quaint projections, the small windows, and the low roofs that characterized those dwellings, but the reality, with the accompaniment of open drains and evil odours, would hardly be so attractive. It was an easy way of getting rid of trouble and responsibility to believe that disease was a sign of Divine wrath, and not the result of certain fixed physical laws. But such was the case, and it was not until the medical inefficiency of superstitious observances and the vanity of fastings and penances had been demonstrated with painful repetition, that the predisposing causes of epidemics began to be seriously dealt with. Little, however, was capable of being accomplished while the public continued steeped in ignorance, while charlatanism and quackery prevailed, and while in the highest quarters and the lowest such barbaric belief survived as was exemplified in the Royal Touch for King's Evil, a custom that existed from the time of Edward the Confessor to the days of Queen Anne. Thus it is that sanitary science is almost entirely the creation of the present century.

In the fourteenth and fifteenth centuries the sanitary condition of all large towns must have been deplorable. The poor were huddled together in miserable hovels, and had to content themselves with but scanty and unwholesome food. Whenever an epidemic drifted over from the East, it found all the conditions favourable to its reception and dissemination.

One of the most terrible pestilences of mediæval times was the Black Death, which fell with such desolating force upon Europe about the middle of the fourteenth century. It is said to have broken out in China in 1334, and to have appeared in Constantinople in 1347, making its way thither by the caravans from Central Asia. In the following year it reached Italy, and wrought such havoc in the "sunny south" that one-half the population fell a sacrifice to its fury. The story of its ravages in Florence forms a gloomy prelude to the lively pages of Boccaccio's "Decameron." Pope Clement VI. shut himself up in his palace-fortress at

Avignon, and burned great fires night and day; he also consecrated the river Rhone, that bodies might be thrown into the river without delay, the churchyards being too full to hold any more. It was not until the last day of May, 1349, that the pestilence made its appearance in England. In London alone 100,000 souls were carried off by this fearful scourge, and in other parts of the country the loss of life was proportionately great. According to Stow, there was a stone cross in the "Spittle Croft, outside West Smithfield Bars," in his time, which bore an inscription recording the fact that 50,000 corpses were buried therein and in the adjoining crypt, and it was not until the London churchyards were full that the Spittle Croft was used. It was estimated that not less than 25,000,000 deaths occurred in Europe from the Black Death. The symptoms of the disease were various. The boils or tumours common to the Eastern plague were frequently seen, but the chief features were a black tongue and black spots over the body. There was also bleeding of the nose, or spitting of blood; and inflammation of the lungs often supervened. The second day generally proved fatal, so rapid was the course of the disease. The medical science of the day was powerless to cope with the epidemic; the remedies suggested by superstition were those mostly resorted to. During the fourteenth century the Black Death spread itself seventeen times over the length and breadth of Europe, and the only effective safeguard that was adopted was the isolation system proposed by Bernardo, in 1379, when, from motives of selfishness rather than of public good, he suggested that every person stricken with the plague should be removed from the city into the fields, and there left to die or live, and that those removing and attending upon them should remain isolated ten days before being permitted to re-enter the city gates. This led the Venetians to establish lazarettes on islands some distance from the city, and as the disease returned from time to time this method was adopted and modified elsewhere until houses for the reception of the sick or the suspected were established at a distance from all large towns. The ignorance and helplessness of the people generally under this visitation of the Black Death is evidenced by the extraordinary religious manias which it called forth. The most famous organization of the period was that of the Order of Flagellants, the members of which body, under the belief that their sins had called down the vengeance of Heaven, formed themselves into vast processions and passed through the streets, armed with scourges, with which they lashed themselves and each other until the "blood gushed out." Morning and evening was this penance repeated, but still the Black Death was not removed. It is some satisfaction to know, however, that the Order of the Flagellants did not succeed very well in England. A band of Flagellants came over from Germany, and lacerated themselves in public in the streets of London, but the English refused to see any true propitiation in this method of meeting disease, so the self-scourgers had to depart without making a single convert.

The epidemic called St. Vitus's Dance broke out in Germany in 1387, and spread through Belgium and Holland with great rapidity, but did not reach England until towards the close of the century. Happily it was not very fatal in its consequences. Attention was first drawn to it at Aix-la-Chapelle, when a number of persons, male and female, were seen "dancing in circles hand-in-hand for hours together, until they fell to the ground in a state of complete exhaustion."

This disease got its name from the fact that "the parties so troubled were wont to go to St. Vitus for help; and after they had danced there awhile they were certainly freed." There is no record of the epidemic having reappeared in anything like the same serious form in Europe at any subsequent date, although the disease in its milder symptoms is by no means uncommon.

Another great epidemic of the Middle Ages was the Sweating Sickness, which first showed itself amongst Henry Tudor's soldiers in 1485, after his landing at Milford Haven, and quickly spread to London, where it continued to rage with terrible effect for more than three months. Its course was more rapid even than that of the Black Death, not more than three hours elapsing in many instances between the first seizure and death. Its visitations to this country were in the years 1485, 1506, 1517, and 1551. It was noticeable that the sufferers were usually men between the age of thirty and forty, and that the healthiest and strongest were the first to be attacked. The symptoms were a sudden sweat, accompanied by faintness and drowsiness; and "those who were taken with full stomachs perished immediately." Medical aid seemed of little avail. Dr. Caius, in his "Boke of Counseill," recommended a facilitating of the sweating; but, according to Holinshed, the only hopeful remedy was for the patient to be "kept close with moderate air, and drink posset ale or such like for thirty hours, and then the danger was passed." Many thousands perished at each visitation of this epidemic. It raged with equal violence in England, France, Germany, Russia, Norway, and Sweden.

The epidemic the most terrible in its associations, the most frequent in its visitations, and the most fatal in its effects, as far as this country is concerned, is what was known as the plague. No one has been able to *diagnose* this disease properly. In fact, the nearest approach to a description of it is that "a poison, the elements of which defy all chemical analysis, is absorbed in the blood, and in a short time changes its composition and the condition of the tissues." Sir Thomas Watson has nothing more to say of it than that "as I have never seen, and never hope to see it; and as, with Cullen, I 'think it unfit for a person who has never seen the disease to attempt its peculiar history,' I shall not presume to offer you any observations in detail." Be that as it may, the plague has been the epidemic most frequently known in England, although it has not visited these shores since 1665. From 430 to 1665 it was never absent for a very long period. At the earlier date the mortality is said to have been so great that the survivors were hardly numerous enough to bury the dead. Thousands died of the plague in London in 962, and we have information of visitations in 1094, 1111, 1361, 1407, and 1471. In 1478 there was another outbreak, of such a serious nature that more people perished by it than had fallen in the sanguinary wars of the preceding fifteen years. In 1499 Henry VII. and his Court removed to Calais to avoid a disastrous visitation of that year. Then, coming down to the seventeenth century, the record becomes more serious. In 1603–4 its ravages were so fearful that 30,578 persons fell victims to it in the metropolis alone; in 1625 the capital again felt the terrors of this scourge, 35,417 persons dying from it in the city. It reappeared in 1630, after which there was a period of respite; but in December, 1664, the Great Plague broke out, being imported into London in some goods from Holland, and first appearing in a house in Long Acre, where four persons died. Nearly three hundred years had elapsed since the Black Death, and still neither the authorities nor the medical faculty were prepared to cope with the disease. Sanitary science was so little understood that the pestilence was allowed to spread without any effectual measures of prevention being adopted. The epidemic continued its course all through the winter and spring, and when the hot days of summer came grew still more virulent. The King and Court fled to Salisbury in July, Monk, Duke of Albemarle, being left, as it were, in command of London. All human concerns, except the one horrible business of battling with the plague and dealing with its victims, were neglected. Upon the door of every house where the disease had shown itself was inscribed a red cross, with the words, "Lord, have mercy upon us!" From 4,000 to 5,000 people died every week, and the work of removing the dead was carried on by night, the carts rattling through the deserted streets to collect the bodies of the victims and convey them to the pits, into which they were unceremoniously thrown without the sacred offices of the Church. The death-rate increased as the year advanced. Writing under date of August 31st, Pepys puts on record the fact that, "In the City died this week 7,496, and of them 6,102 of the plague. But it is found that the true number of the dead is near 10,000." As for the people in the country, they declined to have any dealings with their brethren in London, refusing to buy anything that came from the city, or to allow any of its inhabitants to enter their houses. "When any one bought a joint of meat in the market they would not take it out of the butcher's hands, but took it off the hooks themselves. On the other hand, the butcher would not touch the money, but had it put into a pot full of vinegar, which he kept for that purpose. The buyer carried always small money to make up any odd sum, that they might take no change."

The quacks made a rich harvest with their "only true plague-water," their "infallible preventive pills," and other high-sounding nostrums, but the faculty were wanting even in the pretence of remedies. When the epidemic was at its height in the autumn the King issued a command to the College of Physicians to prepare a series of regulations for the public guidance in preventing and treating the disease; and the Lord Mayor caused great fires to be lighted in all the streets and open places on the 6th of September, in the hope of purifying the air, and these fires were kept burning for three days and nights. The doctors were divided upon the utility of this measure, some contending that it increased the danger, others supporting the proceeding; but, luckily, while the men of medicine disputed, a heavy rain fell, not only extinguishing the fires, but ushering in a colder season, which gradually intensified and put an end to the plague, not, however, until it had carried off its 100,000 victims.

Although the plague has not revisited England since that melancholy period, the country has suffered repeatedly from outbreaks of epidemics, some of which have borne an alarming resemblance, in many of their symptoms, to the former disease. The march of sanitary science was slow and uncertain. Fire and natural decay effected the removal of many plague-spots from the overcrowded cities, and houses and streets were rebuilt upon improved principles; still it was not until comparatively recent times that the architect began to realize the true importance of sanitary provisions.

The epidemic that troubled England the most during this time of transition was the small-pox, which was frequent in its visitations and terribly destructive. There was hardly a family in the country some member of which did not bear the indelible marks of the painful disease. But towards the close of the last century there arose a movement for the prevention of this particular epidemic. It was known that in the East the practice of inoculation prevailed as a remedy against small-pox. Lady Mary Wortley Montague, who had witnessed the process in Turkey, was a strong advocate of its adoption, and Dr. Jenner found immortality by becoming its chief apostle. It was long, however, before he was able to find an opportunity of putting the theory to the test. He was so enthusiastic on the subject that at the medical clubs he used to attend, the members got so tired of his recurrence to the theme that they at length intimated that if he made any further reference to it he would be summarily expelled. But on the 14th May, 1796, his opportunity arrived. On that day he took some cow-pox matter from the hand of one Sarah Nolines, who had been infected from her master's cows, and inserted it by two superficial incisions into the arms of James Phipps, a healthy boy about eight years old. It is recorded that the cow-pox ran its ordinary course without any injurious effect, and the boy was afterwards inoculated for the small-pox, the protection being complete. Jenner now pursued his experiments with full confidence; and, after many difficulties and delays, mainly to be laid at the door of prejudice, his great discovery was accepted by the doctors generally, and the theory of vaccination became established. It is unnecessary here to trace the development from inoculation to vaccination; let it suffice that the protective measures so strongly urged by Jenner were gradually accepted and improved upon, until now we have compulsory vaccination and a gratifying immunity from the disease. In 1723, in London alone, one out of every fourteen deaths was caused by small-pox, and in France, in 1754, the proportion was one in ten. In Russia, not less than two million persons were said to have fallen victims to the disease in a single twelvemonth, about the middle of the century. As vaccination came to be adopted in this and other countries, the mortality from small-pox gradually decreased, and Jenner was hailed as one of the greatest benefactors of his time. In 1802 Parliament voted him a grant of £10,000, and in 1807 a further sum of £20,000. It was not till 1853, however, that vaccination was made compulsory in England, and in Scotland and Ireland two years later. There still exists an opposition party to vaccination, and undoubtedly there are numerous cases in which the introduction of foul matter or *pus* into the system of a child has been productive of pernicious results. The anti-vaccinationists further contend that the large decrease in the number of small-pox cases since the adoption of Jenner's method is due more to improved sanitation than to any virtue that there exists in vaccination. Of the latest development of the principle of vaccination, by which M. Pasteur has sought to combat that most fearful of all contagious diseases—hydrophobia—it is at present unnecessary to say more than that his system is being put to the fullest practical test, and that all Europe is hopefully interested in the results.

The great epidemic of the present century has been the Cholera, which has visited Europe at irregular intervals since 1829, destroying multitudes all along its line of march. This terrible scourge, it is generally agreed, had for its birthplace the great delta of the Ganges, where the pestilential marshes breathe forth organic impurities of the most deadly character. From this bed of disease the poison-shafts have been disseminated with such fatal effect that over fifty million lives have been sacrificed by them. So clearly is this to be traced that more than one eminent authority has proposed to try the experiment of stamping it out at its starting point by canalizing the delta of the Ganges, and by drainage and cultivation removing the seeds of pestilence. There is little doubt the disease had been long familiar in the East before making its way to northern latitudes. One of the earliest instances of Europeans being attacked by it occurred during the operations of the Marquis of Hastings in India in 1817. While he and his army of over 10,000 Europeans and a much larger native force were in the Bundelcund, not far from Allahabad, the European troops fell under the epidemic, which proved fearfully destructive amongst them. It continued with unabated severity, until early in November the army was moved westwards towards Gwalior, thousands of dead and dying being left behind. Happily, the removal of the troops from the infected locality gave them relief.

It was in the Russian town of Orenburg, on the Ural, that cholera made its first appearance in Europe, having travelled, it is supposed, by way of Persia. In 1830 it made a further encroachment, spreading with fatal force over various parts of the Czar's dominions the great epidemic of Moscow beginning in September, and numbering among its victims many distinguished people. In the following year cholera broke out at Sunderland, Newcastle, Gateshead, and Shields, but London remained exempt until the spring of 1832. Most of the English seaports were attacked in the summer of that year, and it was taken across the Atlantic by Irish emigrants, and made its way to several of the principal cities and to the Upper Mississippi, where it very seriously interfered with the military operations against the Indians. The disease did not leave Europe entirely until 1837, after which the pestilence absented itself from the western world for a full decade. The year 1847 saw the return of the epidemic with redoubled fury. It advanced again through Russia and spread itself over the whole of Europe, its victims being counted by thousands in all the great centres of population, the overcrowded and less healthy parts of our towns being the chief seats of the attack. From 1847 to 1853 Europe was once more free from cholera, but in the last-named year it raged with fearful violence in St. Petersburg, advancing along the Baltic coast, and reaching London and Liverpool in July, though not becoming epidemic until a year later. Another visitation occurred in 1865, the starting point, curious to say, being at Altenburg, a town in the very middle of Germany. How it got there was an inexplicable mystery. It spread, however, from that district over other parts of Germany, and in July, 1866, appeared at London and Liverpool, though the visitation was less serious than on former occasions. From that time to the present we have had an immunity from the disease in this country, although between 1873 and 1875 it appeared in a somewhat subdued form in certain parts of Germany.

From the time of the first outbreak of cholera in Europe there has been going forward a gradual improvement in matters of sanitation, and, when we consider that all epidemics are specially fostered by impure conditions of living, it is not too much to say that to this improvement more probably than anything else is due the continued absence of great epidemics. Medical science has expended much thought and skill upon the investigation of the tangible cause of cholera; but as yet without a well-defined result. Dr. Koch was sent to India by the German Government in 1883 to look into this matter, and his conclusions, after the most careful inquiry and examination, were as follows:—That the unknown entity (the germ) in cholera has the form of a curved rod, which Dr. Koch likens to a comma, as written not printed, and that the disease is caused by the presence, growth and multiplication of this organism in the apparatus for absorption, contained in the lower part of the small intestine, and by the consequent formation there of an animal poison, which produces collapse and the other fatal effects of cholera. Subsequent to this our own Government sent out a special Commission for the purpose of reporting generally on the practical bearing of the German investigations. Dr. Klein was at the head of the Commission, and after due investigation, the report was that, although Dr. Koch was perfectly accurate in his statement of fact, he had gone too far in inference. It has to be admitted, however, that the real bacteriological cause of cholera is still undiscovered. Meanwhile, sanitary measures diminish the mortality from cholera even in India, and it is in that direction that there seems to be the most hope.

About 1832, Dr. Southwood Smith drew attention to the subject of public health, and for many years he continued to publish books, pamphlets, and reports bearing on this subject, and in course of time the Government were induced to take the matter up, and numerous Acts designed for the prevention of epidemic disease were passed, including the Public Health Acts of 1848, 1855, 1872, and 1878, the latter being a consolidation of previous Acts. In 1851–3 the Common Lodging Houses Act came into force, introducing many useful regulations bearing on the health of the poor. Then, in 1855, there was the Diseases Prevention Act; in 1866 the Labouring Classes Dwelling Houses Act; in 1866, 1868, and 1870 further Sanitary Acts were passed; 1874 witnessed the enactment of the Public Health Act for Ireland; and in 1874 the Sanitary Laws Amendment Act came into operation.

Contemporaneously, private effort effected much good. The National Health Society was founded in 1873; there was an International Sanitary Congress at Vienna in the year following; the London Sanitary Protection Association was established in 1881, Sir William Gull, Professor Huxley, and others being amongst its founders; from the 16th July to the 13th August, 1881, there was an International Sanitary Exhibition in the Albert Hall; International Sanitary Congresses were held at Washington in 1881, and at Geneva in 1882; the International Health Exhibition was held in 1884; and in the same year the Fifth International Sanitary Conference took place at the Hague. All these various movements evidenced the strong interest of the public, and the increased activity of the authorities in regard to the prevention of disease.

Mr. Edwin Chadwick was an eminent worker on behalf of the public health for many years. Indeed, he has been called "the Father of Sanitary Reform," and not without cause. In his early manhood he advocated many measures of public utility, and, after his appointment to an official position in 1832, was the means of introducing several effective reforms bearing on the condition of the labouring population. It was at his suggestion that the Poor Law Board instituted an inquiry into the question of the housing of the poor. Subsequently, he received the appointment of Chief

Executive Officer of the first General Board of Health, and during the five years of the existence of this body sanitary principles were elaborated and applied to a number of towns, with the result that the death-rate was in some cases reduced to one-fourth, and even in one or two instances to one-third the former rates. His designs for improved sanitary dwellings, which have served as the models for so many that have been since erected; his suggestions for the better administration of the parochial system of poor relief; and his numerous writings on kindred matters have been of great national benefit. It has been well said of him that, "he has made laws, yet he was never a legislator; he has well-nigh revolutionized our national sanitary arrangements, yet he was no doctor; he has taught some of the higher, because most practical, principles of education, yet he was no professor." Many other scientific men—amongst whom Dr. W. B. Richardson deserves honourable mention—have addressed themselves to the practical study of sanitary subjects, with the most beneficial results to the community. It has been by the persistent efforts of such men that the various public authorities have gradually come to recognize their duties in these matters; and the Boards of Health and Medical Officers that are now to be found in all the large centres of population, and even in the rural districts, constitute an admirable testimony to the growth of precautionary principles, and give an assurance of scientific care and attention in strong contrast to the neglect that prevailed in the past. A separate chapter might easily be written upon the subject of sewerage, and another on water supply—matters which have been of the utmost importance in working out this gigantic problem of sanitary reform. There is an abundance of blue-book literature on these heads, setting forth the reports of Royal Commissions, Select Committees, and the like, and forming the basis of much useful legislation.

It is nowadays pretty widely—though not universally—recognized, that overcrowding, the accumulation of filth in and about dwellings, personal uncleanliness, improper food and impure water, stagnant ditches, foul drains, marsh lands, and similar evils, are predisposing causes to disease, and it is to the removal of some of these causes that the Public Health Authorities strive to adapt themselves. The principles of general hygiene here indicated form the best preventive of disease; and, in cases of infectious maladies, the methods of isolation now provided for by the later developments of our hospital system are the best safeguards.

CHAPTER XX.

THE STORY OF ANAESTHETICS.

THE cup of Lethe belongs not to the ancients, but is the outcome of our own time. From Homer downwards, the poets have sung of draughts of sweet forgetfulness and repose-inspiring decoctions, but only, for the most part, as ministrations to pleasure or minimizers of mind-weariness ; neither the fancies of poetry, nor the facts of past history have realized such a complete pain-destroyer as that which is revealed in the modern story of anaesthetics. In all ages recourse has been had to plants possessing anaesthetic properties, and opiates have always been a powerful agent in the hands of those practising the medical art ; for all that, the discovery of an effective allayer of physical pain—an agent capable of temporarily suspending the action of the sense of feeling—is one of the matters we have to set to the credit of nineteenth-century science.

It has been attempted to penetrate the mysteries of that nepenthe of which the Odyssey speaks, which delivered men from grief and wrath, and caused oblivion of every ill ; but doctors differ upon this as on other points, some holding that it was a preparation of opium, while others incline to the opinion that it was Indian hemp boiled in wine. Pliny, Dioscorides, and other ancient philosophers make repeated references to anaesthetic plants and substances, foremost among them being mandragora, or mandrake-root, while what was known as Memphite stone was regarded as of great efficacy in producing local anaesthesia. The mandragora was of the deadly nightshade family, and was largely used, both under medical advice and as a soothing opiate for private use. The Emperor Julian, it is said, took nightly draughts of this magic sleep-inducer, and this and kindred decoctions formed the chief portion of the pain-alleviating agents of the olden time. When Iago had set his subtle poison at work in the mind of Othello, the devil within him rejoiced that

> "Not poppy, nor mandragora,
> Nor all the drowsy syrups of the world
> Shall ever medicine thee to that sweet sleep
> Which thou ow'dst yesterday."

The gentle Juliet may be supposed to have received from Friar Lawrence an even more powerful potion, sending through her that "cold and drowsy humour" which produced such a close simulation to death as to be actually taken for it. The indications given by Middleton in his tragedy, *Women beware Women*, seem to point directly to the use of anaesthetic agents in surgical operations. He says:

> "I'll imitate the pities of old surgeons
> To this lost limb; who, ere they show their art,
> Cast one asleep, then cut the diseased part."

As for the Memphite stone, modern science—which finds time to compare notes with the ancient wonder-workers as well as to prosecute its own particular researches—has formed a very plausible theory concerning it. It was known that the stone used to be pounded and mixed with strong vinegar, and that the paste thus produced was applied to the part affected.

If, as was no doubt the case, the stone possessed the properties of marble, it would throw off carbonic gas by the action of the acetic acid in the vinegar, and this gas would be the element which would yield the anaesthetic power.

According to Herodotus, a decoction of hemp, which must have borne some resemblance to the *bhang* or *hashish* of modern Orientals, was used for anaesthetic purposes by the Scythians; and it is on record that the Chinese administered a preparation of hemp for the like objects as early as the third century. The ancient Assyrians — we have it on the authority of Aristotle—adopted a rather rough-and-ready method of relieving the patient from local pain when certain surgical operations were to be undergone. They produced anaesthesia by forcible compression of the veins of the neck.

Instances of the application of agents containing anaesthetic qualities, previous to the present century, are numerous enough, but the precise nature of those agents is not always ascertainable. In the Middle Ages, when quackery of every description was rampant, it was easy to impose upon a too credulous public with medicines professing to exorcise pain, and if these preparations did not always in themselves completely answer expectation, by the assistance of faith and imagination conditions would not fail to be induced favourable to the alleviation of suffering. We are told that Augustus II. of Poland was relieved of pain by some secret agent, while a trying operation was performed upon his foot; and amongst the stories which have descended to us of men condemned to the terrors of the mediæval torture-chamber, we find it stated that money or influence was often able to procure from the gaolers a secret potion whose action would yield "surcease of sorrow" until the cruel ordeal had been passed.

Opium and other narcotic drugs were frequently used for protection against pain in ages gone by. A curious recipe has been handed down to us from Theodoric, a pupil of Hugo, who lived in the latter half of the thirteenth century, and wrote a book on surgery. In this work he gives an elaborate prescription for the concoction of "a flavour for performing surgical operations" without causing pain to the patient. The recipe runs thus, and is said to be "according to Dominus Hugo":—"Take of opium, of juice of unripe mulberry, of hyoscyamus, of the juice of the hemlock [*cicuta*], of the juice of the leaves of unripe hemlock, of the juice of the wood-ivy, of the juice of the forest mulberry, of the seeds of the lettuce, of the seeds of the dock that hath a large apple [*Datura*], each an ounce; mix all these in a large brazen vessel, and then place it in a new sponge; let the whole boil as long as the sun lasts in dog-days, until the sponge consumes it all. As oft as it is required, place this sponge in hot water for an hour, and let it be applied to the nostrils of him who is to be operated upon, until he has fallen asleep, when the operation may be performed." In these various ingredients were included some of the most powerful narcotic vegetables known to us at the present day.

Baptista Porta, in his work on "Natural Magic," published in 1608, gives recipes of a somewhat similar kind, amongst them being one for a "sleeping apple," whose principal constituents were mandrake and opium, the flavour of which had to be inhaled by the nose. The mandrake, however, was gradually superseded by the deadly nightshade (*Atropa belladonna*) for these purposes. Opium, which is the dried juice of the seed-vessels of the common white poppy, has been in use for ages as a soother of pain and inducer of sleep, its leading element being the alkaloid called morphine; and as far back as the thirteenth century, Raymond Lully, the alchemist, had an acquaintance with the properties of ether; indications of a similar knowledge being given in the fifteenth century by Basil Valentine, and in the sixteenth by Valerius Cordus, who gave particulars how to make it. In the light of these facts it seems not a little surprising that it was not until about the middle of the present century that ether was utilized for producing insensibility to pain.

Keats, with that delicate perception of physical feeling which was a marked characteristic of his poetry, alludes to the sensation which the application of anaesthetic agents induces. It occurs in the opening of his exquisitely dreamy "Ode to the Nightingale":

> "My heart aches, and a drowsy numbness pains
> My sense, as though of hemlock I had drunk,
> Or emptied some dull opiate to the drains
> One minute past, and Lethe-wards had sunk."

It was not until long after Keats's time, however, that the science of anaesthetics began to stir the minds of the faculty. Experiments of a desultory character had been indulged in from time to time, with fairly satisfactory results, but no master mind had been engaged upon the subject, and little general progress had been made. Mr. James Moore, an English surgeon, borrowing an idea from the ancient Assyrians, advocated compression of the large nerves as a means of averting pain, some time towards the close of the last century, and obtained permission to try the method upon a patient in St. George's Hospital. This was a case of leg amputation, and the operator was none other than the famous John

Hunter. The experiment was so far successful that it was only when it came to the sawing of the bone that the patient showed signs of uneasiness. Mr. Liégard, of Caen, followed on similar lines a little while later, having, by the aid of a tourniquet applied to the leg, been able, in two cases, to remove a toe-nail without pain. But none of these attemps at pain-annihilation was sufficient to establish a new surgical departure, or even to invite much imitation; the true theory of anaesthetics remained hidden away amongst a thousand other secrets which Nature held in reserve as rewards for the more intelligent searchers into her mysteries.

Such a searcher was Sir Humphry Davy. In 1798, when he was but twenty-two years of age, and plain Humphry Davy, unknown to fame, and plodding away with zeal and diligence as a doctor's apprentice at Bodmin, he chanced upon a discovery which not only drew attention to his own personality, but set the world of science aglow with new thoughts. He was but a lad of twenty-two, yet his investigations in the study of chemistry and natural philosophy were of such a remarkable character that they brought him into association with some of the best minds of his time. Dr. Beddoes, of Bristol, evinced a lively interest in Davy's experiments, and it was at his suggestion that the doctor's apprentice removed to Bristol and accepted the post of superintendent of the Pneumatic Institution, which had been established at Clifton for the purpose of testing the medical effects of certain gases. After two years of assiduous study and experiment, Davy was enabled to publish his remarkable "Researches, Chemical and Philosophical, chiefly concerning Nitrous Oxide," which an eminent man of our own day, Sir James Paget, has spoken of as an essay "proving a truly marvellous ingenuity, patience, and courage in experiments, and such a power of thinking and observing as has rarely, if ever, been surpassed by any scientific man of Davy's years."

Amongst the various properties of nitrous oxide, Davy discovered one striking peculiarity. When he accidentally inhaled the gas he experienced many strange but not unpleasant sensations. His imagination was excited, he felt a greatly increased mental activity, and became restlessly jubilant. Trying the inhalation upon others, he observed similar results. So merry did it make people that by common consent it had the name of "laughing gas" given to it, and in the cause of mirth rather than of medicine for many years came to be frequently resorted to.

Unfortunately for medical science, Humphry Davy's researches were directed to other studies and wider issues, but he left to the surgical art a legacy of suggestion which, though slow of fruition, was destined to yield important results. He had noticed that, besides its mirth-producing power, "laughing gas" was able to produce temporary insensibility, and he wrote:—"As nitrous oxide in its extensive operation appears to be capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place." Strange to say, the doctors did not accept the hint, or make the least attempt to put Davy's theory to the test of practical experiment, simple as it was and plainly as it had been demonstrated. Nearly half a century elapsed before nitrous oxide gas was medically used as a means of producing insensibility to pain.

In 1832, a M. Dauriol operated upon persons made insensible by the use of ether containing sedative substances,—hemlock, henbane, or stramony. This was a step in the right direction, but still no permanent result seemed to be arrived at. Dr. Smilie, a dozen years later, used ether, combined with tincture of opium, for producing insensibility prior to performing surgical operations, and was in a great measure successful; he, however, had not sufficient confidence in his plan to continue it. Doctors, generally, fought shy of anaesthetic notions through fear of injurious consequences. And so the grand idea which Humphry Davy had given to the world, as well as all kindred suggestions, was allowed to rest without practical benefit being derived from it, until December, 1844, when, remarkable to relate, the idea was revived in America and had fresh life and purpose given to it.

One bitter cold night about Christmas time, 1844, a number of the citizens of Hartford, in the State of Connecticut, had been drawn from their firesides to listen to a lecture by Dr. Gardiner Q. Colton on certain gases. The lecturer was very popular in those parts, for he had a happy knack of combining amusement with instruction,—a rarer gift in those days than now. Amongst the diversions to which he treated his audience there was none that gave so much satisfaction as that which illustrated the effects of nitrous oxide. Several persons had the gas administered to them, and while under its influence indulged in such merry antics as excited the hilarity of the assembly. The genuineness of the experiments was proved by the fact that the people operated upon were well-known Hartfordians, and not persons in the pay of the doctor. It was considered splendid fun to see respectable citizens conducting themselves like clowns at a fair.

Amongst the audience was a local dentist named Horace Wells, who was interested in the scientific aspect of the matter. Wells noticed that when a Mr.

Samuel Cooley, whom he knew very well, was under the spell of the gas, and knocked his legs violently against one of the benches, bruising himself severely, he uttered no cry of pain, nor did he show the least sensibility to the injuries he had sustained. This incident set Wells thinking. He saw in it the very thing that Davy had indicated forty-five years before, and, like a true Yankee, resolved to utilize the idea in his own business. He did not say anything to his friends about his intentions that night, but the next morning called upon Dr. Gardiner Q. Colton, along with Dr. Riggs, a brother dentist, and asked to be put under the influence of the gas. While so acted upon, as had been previously arranged, Dr. Riggs extracted one of Wells's molars, the latter feeling nothing of the operation whatever. Elated by the success of his experiment, Wells induced Colton to teach him how to make the gas, and subsequently administered it to some dozen patients with equally satisfactory results. He now desired to make a public demonstration of the anaesthetic properties of the gas, and was allowed to make an experiment upon one of his own patients at the Boston Hospital, under the supervision of Dr. Warren. A large number of the faculty attended to witness the experiment, but with no very friendly feeling towards the tooth-extractor, whom they considered to be trenching on ground made sacred to them. The patient was placed in a chair, and the gas was applied. But, from some cause or other, the moment the dentist fixed his instrument and attempted to wrench the offending tooth from its place, the owner of it uttered a piercing cry. The upshot may be imagined. Wells was laughed at and derided. They called him an impostor, and shook their empty heads as if they had been full of wisdom, remarking, with a smile of satisfaction, that they had known how it would end. And that was about the last that was heard, in a public way, of Horace Wells. Not having the courage of his convictions, and being weighed down by a super-sensitiveness that scarcely accorded with his profession, he did not take the trouble to explain that the inhalation had not been long enough to effect the result aimed at, but vanished from view and shrank back into the obscurity from which the "laughing gas" had first dragged him, dying shortly afterwards.

After Wells's death, Dr. Colton turned his attention to the question of making practical use of nitrous oxide as an anaesthetic; but he received scant encouragement from those whose interest he sought to serve. For nearly twenty years the dentists of America refused to have anything to do with the anaesthetic, but persisted in their old-fashioned method of extraction by torture. It was not until 1863, when Dr. Joseph H. Smith, of Newhaven, Connecticut, was prevailed upon to use the gas upon a patient, that Dr. Colton's unwearying efforts began to attract notice. When once the dentists of America had had their eyes opened to the true merit of the discovery, however, they soon made up for lost time, for in 1867, when Dr. Colton proceeded to Paris for the purpose of enlisting the favour of the French faculty, he was able to take with him "a clean record of 20,000 successful administrations without a single accident," although even that strong testimony was not sufficient to surmount the barrier of professional prejudice behind which the Paris doctors inertly screened themselves. Colton was more fortunate in London. Mr. S. Lee Rymer had introduced nitrous oxide experiments into England in 1864, and, later on, Dr. Evans, an American dentist, brought Colton's apparatus to London, and, in the presence of the staff of the Dental

Hospital, administered the gas with complete success. But there were two serious hindrances to its general adoption. In the first place, it was difficult and costly of production; and, in the next place, it demanded a certain chemical skill in manipulation, which not many dentists possessed. In time those objections were overcome by the utilization of Faraday's discovery that by submitting the gas to a pressure of 750 lbs. on the square inch it assumed a liquid form, and, thenceforth, when it became possible to send the gas out in wrought-iron bottles, furnished with stop-cocks, the process of administration was simplified to such a degree that it was not long before Davy's discovery of 1798 was in universal application as an anaesthetic agent for dental operations.

A more potent anaesthetic was found in sulphuric ether. As far back as 1818, Faraday had disclosed the fact that this gas was capable of inducing insensibility; but, as in the case of Davy and his nitrous oxide, the scientific deduction had to travel a long way, and spread itself over many years, before it could gain acceptance. An English doctor named Long, practising at Athens, made use of ether in several surgical cases with success in 1842, but left no record of procedure or results; in the same year, however, acting quite independently, Dr. Jackson, an American, brought this agent into notice as an anaesthetic. He was led to it by a rather curious accident. While preparing some chlorine gas for the illustration of a lecture, the bottle containing the gas fell and broke, and as the antidote to the suffocating fumes, he inhaled a quantity of sulphuric ether and ammonia, under the impression that the inert salt, chloride of ammonia, would be formed. Gradually, however, he fell off into a condition of perfect anaesthesia, and when he subsequently recovered sensibility, his first thought was that he had discovered a pain-destroyer of greater efficacy than anything that had been previously resorted to. But, as usual, it was not an easy matter to convince others of the truths of a new discovery. It took four years of lecturing and elucidation—four years of hard argument and demonstration—before he could induce any one to act upon his suggestion. Ultimately, in September, 1846, a Boston dentist, named Morton, secured immortality by experimenting with ether. He had already made himself acquainted with the properties of nitrous oxide gas, and was favourably disposed towards a further examination of the subject of anaesthetics. When, therefore, Dr. Jackson gave him some ether, he, first of all, tried the effects of it on himself, and afterwards extracted a tooth without pain from a patient under its influence.

Mr. Morton immediately brought the matter under the attention of the leading members of the faculty in the locality, and at the Massachussetts General Hospital, in the presence of many who had witnessed Horace Wells's failure with nitrous oxide a year or two before, he succeeded in throwing a couple of patients into a perfect condition of anaesthesia while Drs. Warren and Hayward performed two painful operations upon them. The profession now began to assume a less sceptical attitude towards the apostles of anaesthetics, and there grew up a desire to experiment with the new pain-killer. Dr. Bigelow, of New York, gave increased fame to it by two successful operations. He cut out the inferior jaw of one patient and amputated the thigh of another painlessly while they were under the influence of the narcotic.

Up to this time Dr. Jackson had sought to keep the precise nature of the anaesthetic a secret. He christened it Letheon, and endeavoured to shadow it with mystery. Dreams of vast wealth arose in his mind as he thought of himself as the only purveyor of this powerful charm-worker, which must soon be in demand all over the civilized world. But the dreams were not to be realized even to a small extent. Dr. Bigelow at first suspected the presence of sulphuric ether by the smell, and, after submitting the mystic Letheon to proper scientific tests, satisfied himself that it was ether and nothing else. His next surgical experiments were with sulphuric ether of his own providing, and the success was as great as before. After this it was useless in Dr. Jackson to pretend to make a secret of his Letheon; Letheon accordingly, after a very brief service as an empty name, passed into oblivion, and sulphuric ether—so called from its being made by the action of sulphuric acid on alcohol—was proclaimed far and wide as the new anaesthetic.

On the 28th of November, 1846, Dr. Bigelow communicated the result of his experiments to Dr. Booth, of London, and in the following months the first trial in England of ether as an anaesthetic took place at Dr. Booth's house. During the same month Mr. Liston used ether with complete success in two serious cases—the amputation of a thigh, and the extraction of a toe-nail. The use of ether now became general, and in January, 1847, Dr. Simpson, of Edinburgh, employed it with the best results in an obstetric case. A few days before he had been appointed one of Her Majesty's Physicians for Scotland, but in a letter to his brother at the time he expressed himself as far less interested in this new honour than in the success of his experiment with sulphuric ether.

From that time the name of Doctor (afterwards Sir)

James Young Simpson became closely identified with the study of anaesthetics. He approached the subject with a due sense of its importance, and applied to it a scientific skill of the first order. Several deaths occurred through the careless and indiscriminate use of ether, causing that agent to be regarded with diminished favour. A less dangerous but equally effective substance was called for, and to the discovery of this Dr. Simpson devoted his best energies. In his researches he was assisted by several able professors, and for a time they gave a large share of their attention to the matter. Any volatile substance in which anaesthetic properties were suspected was carefully examined, and it was not long before the experiments brought forth the coveted reward.

One night Dr. Simpson and his assistants were sitting up late, bent on their self-imposed task. A number of chemical fluids had been selected for experiment, each man providing himself with a glass, into which a small quantity of the particular substance engaging attention was poured, the glass being placed over warm water to help the evolution of vapour. In this way, with their mouths and nostrils held over the vessels, they tested one vapour after another, but it seemed as if the spirit of unconsciousness was not to be evoked. They tried many gases and liquids which no one had ever thought of testing in this connection before, and at last a small bottle of ponderous liquid, which provoked no great expectations, and was only known as a chemical curiosity in the laboratory, was raked up out of some obscure corner and put to take its turn with the rest. This was a small bottle of chloroform. Presently, after more promising substances had failed them, it was resolved to submit it to the test. A small portion of the liquid was poured into each glass and the experimenters began their inhalations. Professor Miller, one of the assistants, has described what took place. An unwonted hilarity seized the party; they became bright-eyed and very happy, and conversed with such intelligence as more than usually charmed other listeners, who were not taking part in the proceedings. But, suddenly, there was a talk of sounds being heard like those of a cotton-mill, louder and louder; a moment more, then all was quiet, and then—a crash! On awaking, Dr. Simpson's first perception was mental. "This is far stronger and better than ether," he said to himself. He next observed that he was prostrate on the floor, and that his friends were confused and alarmed. Hearing a noise, he turned round and saw his assistant, Dr. Duncan, beneath a chair; his jaw dropped, his eyes staring, and his head half bent under him; quite unconscious, and snoring in a determined and alarming manner. More noise followed, and much commotion, and then his eyes overtook Dr. Keith's feet and legs making valorous efforts to overturn the table, or more probably to annihilate everything that was upon it. All speedily regained their senses, and from the middle of that night dates the discovery of the anaesthetic uses of chloroform.

The new anaesthetic soon almost entirely superseded the use of sulphuric ether. The substance had been first discovered and described, almost simultaneously, by Souberian in 1831, and Liebig in 1832; while its composition was accurately ascertained by the eminent French chemist, Dumas, in 1835. Its advantages over ether were thus summarized:—1. A greatly less quantity was requisite to produce the anaesthetic effect. 2. Its action was much more rapid and complete and generally more persistent. 3. Its inhalation and influence were more agreeable. 4. A smaller quantity being used, it was less expensive. 5. Its odour was far from being unpleasant, and did not long remain attached to the clothes of the attendant. 6. It was more portable and transmissible. 7. No special kind of inhaler or instrument was necessary for its exhibition.

On the 10th November, 1847, Dr. Simpson made a communication on the subject to the Edinburgh Medico-Chirurgical Society, and from that time it was established in the leading position as an anaesthetic. But, great as the benefit was that was conferred upon suffering humanity by this powerful agent, there were not wanting those who looked upon its use as an insult to Providence. Pain, they maintained, was ordained by the Creator, and to seek to annul physical suffering was in the highest degree sinful. Even the chief of the Army Medical Staff recommended the surgeons, during the Crimean war, not to use chloroform, asserting that the pain inflicted by the knife was a wholesome stimulus, and its abolition was likely to be injurious. These objections notwithstanding—and the more serious objection of occasional deaths under its influence—it long held its ground as the chief anaesthetic, and in all ordinary circumstances could be administered with safety.

More recently, however, ether has again found its way into favour, and is now the most generally used of anaesthetics. In the period between the discovery of the anaesthetic properties of ether and the introduction of chloroform, ether was used by men of insufficient skill, and the numerous deaths then set against it caused it to be regarded as highly dangerous; but now that it is better understood, and the manner of its administration is simplified and improved, it is considered even safer than chloroform, its stimulant effect upon the action of the heart being of great importance in sustaining the vital powers.

Occasional recourse is had to other anaesthetic substances, but they are less certain in their action than the three leading anaesthetics—ether, chloroform, and nitrous oxide. Sir Spencer Wells has used bichloride of methylene with advantage in abdominal operations, and the same agent has been much used in ophthalmic surgery. Some recommend a mixture of the various anaesthetics, but none of these compounds can compare in reliability with the three principal agents.

Pain has its uses in warning us of physical dangers, and is one of the conditions of our existence; still, every contribution to its alleviation is an addition to the sum of human happiness. The men who have been concerned in the preparation of the Lethean draught which has robbed the surgeon's knife of its terrors, and helped in a striking degree the advancement of medical science, have good cause to be remembered with gratitude. Far from opposing the operations of nature, it is to nature they have resorted for an antidote against these developments of pain which may be properly described as abnormal.

CHAPTER XXI.

THE ROMANCE OF DIETETICS.

"IN the years to come it will be debated whether the great minds of the later Victorian era were most concerned with their souls or with their stomachs. Politics we may put by; they are always with us; but, politics apart, between these two interests, the spiritual and the peptical, the question of precedence must surely lie. What other claimant can there be? Not literature, thrust away into corners, or tricked out in a newspaper like some May-day mummer; not art, divorced, in Carlyle's phrase, from sense and the reality of things; not music, crushed Tarpeiawise under foreign gewgaws, or brayed in a chemist's mortar; not the drama, levelled to a tawdry platform for the individual's vanity. Not these things, nor any one of these things; but the soul and the stomach, irreligion and indigestion, doubt and dyspepsia—call them what you will—these are the cardinal notes of our great inquiring age." So wrote "A Layman" not long ago in an article entitled "The Philosophy of Diet," in one of the monthly magazines, and upon which even the *Lancet* ventured to descant with favour. In the eventuality prognosticated by "A Layman," the history and romance of dietetics must form the most important factor from which the future generation will evolve its conclusions. With regard to its history, Sir Henry Thompson expresses the opinion that our forefathers did not sufficiently consider this great subject. He commends their care of our morals, and sees a wise and lofty purpose in the laws they framed for the regulation of human conduct, and the satisfaction of the natural cravings of religious emotions. But those other cravings, equally common to human nature, those grosser emotions, cravings of the physical body, they have disregarded. "No doubt," he says, "there has long been some practical acknowledgment, on the part of a few educated persons, of the simple fact that a man's temper, and consequently most of his actions, depend upon such an alternative as whether he digests well or ill; whether the meals which he eats are properly converted into healthy material, suitable for the ceaseless work of building up of both muscle and brain, or whether unhealthy products constantly pollute the course of nutritive supply. But the truth of that fact has never been generally admitted to an extent at all comparable with its exceeding importance." On the contrary, there always has existed a large class of persons who imagined that just as the fire will burn all consumable material more or less quickly, so the human body demanding, as it does, so much nutriment, would be content with whatever food could be shown to contain anything in the way of digestible material. There is a very serious error involved in this mode of thought, which possibly characterized our ancestors, more than the present generation, although it was not owing to the fact that the teachers of their day did not point out to them the error. Plutarch was averse to a too solid diet, for the reason that it does "very much oppress" those who indulge therein, and is apt to leave behind "malignant relics." Moreover, such prophets as Conaro and Cheyne, Abernethy and Jephson, preached strenuously against the dietetic errors which prevailed at the commencement of the current century, and Sir Henry, in his turn, would not have men to be great eaters of beef. He is very sure of the influence man's diet has on his conduct. "It is certain that an adequate practical recognition of the value of proper food to the individual in maintaining a high standard of health, in prolonging healthy life, and thus largely promoting cheerful temper, prevalent good nature, and improved moral tone, would achieve almost a revolution in the habits of a large part of the community."

Notwithstanding the dietetic mistakes of their time, however, the ancients were by no means devoid of thought upon the stomachic influence, for always through the years wise men who studied the conduct and character of their kind have commended moderation in gratifying the appetite, and lashed indulgence. The writer already quoted points out that Milton, in a famous passage, has chanted in his solemn music the praises of a sleep which "was aëry light from pure digestion bred"; and Pope, with equal truth, reminded his fellows "how active springs the mind, which leaves the load of yesterday behind." They did not believe in a written law for these things; the doctrine and bearing of their sermons is thus summed up—"Be not unsatiable in any dainty thing, nor too greedy upon meats. For excess of meats bringeth sickness, and surfeiting will turn into choler. By surfeiting have many perished, but he that taketh heed prolongeth life." Tiberius, says Tacitus, held that man a fool who at the age of thirty years needed another to tell him what was best to eat, drink, and avoid. "There is," says Bacon, "a wisdom in this beyond the rules of physic; a man's own observation what he finds good of and what he finds hurt of is the best physic to preserve health." The melancholy Burton concludes that "our own experience is the best physician; that diet which is most propitious to one is often pernicious to another. Such is the variety of palates, humours, and temperatures, let every man observe and be a law unto himself." The Conaro to whom we have alluded was a native of Padua, and was as wonderful an old gentleman as the amiable M. Chevreul of Paris, who in August, 1887, completed his one hundred and second year, and, as the saying goes, "still retained all his faculties unimpaired." At the age of eighty-three he published his "Discorsi della Vita Sobria"—a treatise upon how much a sober life could do; and he repeated his discourse at the age of ninety-five, not finally disappearing from the world's stage until he had passed the century.

The quantity rather than the quality of what men ate was the ruling law with the wise men of old; measure was the one thing needful. Conaro, by the time he had reached the age of thirty-six, had accustomed himself to a daily measure of twelve ounces of food and fourteen of drink; but he does not appear to have had any scruples as to what he ate, neither did he shun wine. "I chose that wine," he says, "which fitted my stomach, and in such measure as easily might be digested." Dr. Lessius, another authority in the seventeenth century, does not commit himself to any measurement or scale. He says, "If thou dost usually take so much food at meals, as thou art thereby made unfit for the duties and offices belonging to the mind, it is then evident that thou dost exceed the measure that thou oughtest to hold." He tells, on ancient authority, some marvellous tales of the little men have found enough to keep body and soul together; how one throve through a long life on milk alone, how another lived for twenty years on cheese—instances which we shall amplify further on. But he insists, as do all the ancient sages, that the measure must vary with the age, condition, and business of the man. The golden mean must vary in all sorts of people is the burden of their song, "according to the diversity of complexions in sundry persons, and of youth and strength in the self-same body." Again: "A greater measure is requisite to him that is occupied in bodily labour, and continually exercising the faculties of the body, than to him that is altogether in studies." On this point all agreed. Life, we conclude, therefore, is warmth, growth, repair, and power to labour, and all these are derived from the food we eat, and the fluids we drink—and these should be good.

The foods of barbarous and semi-civilized people are the most varied and remarkable. We should not expect to find so much variety as actually prevails, for instance, among the Esquimaux. The icy deserts of the huge island of Greenland, cut off from all intercourse with Europe ten months in the year, are scarcely the locality in which a traveller might expect to find that quality. Seal-flesh is their staple food, although many Europeans have such a repugnance to it that they almost regard the taking of it as an immoral act. Pasties made of seals' livers are regarded in Greenland as great delicacies, and are the pride of the Esquimaux housewives; for there are rules and regulations even for a Greenlander's kitchen, and the art of cooking enters largely into making palatable or otherwise the numerous kinds of seal-flesh. Mikiak is the name given by Greenlanders to the half-frozen, half-rotten flesh of the seal, which in certain parts of the island forms the principal provision of the inhabitants. It is poor fare, but when fish and seals have failed for any length of time it becomes an enviable tit-bit, and is devoured with as keen a relish as if it were hare or game. The sufferings of the Greenlanders from famine are indeed terrible at times, and they frequently have to quiet the cravings of their stomachs with mussels and seaweed, and often old sealskins, not sparing the ragged skins which cover the roofs of their wretched hovels. When, after some such period of deprivation, the seals once more appear, the suffering inhabitants can hardly be very much blamed if they do commit extraordinary extravagances of eating—extravagances which, nevertheless, compel penalties in return. The highest mortality in Greenland occurs not in the time of famine, but in the time of plenty—an apparent confirmation of the adage that more die of eating too much than eating too little, as in the case of the little girl in Western Pennsylvania, who ate twelve saucerfuls of ice creams, and died in two hours! Such instances might be vastly multiplied nearer home than "Greenland's icy mountains," or the continent of America. Another favourite food of the Greenlanders is provided by the whales and the dolphins which are sometimes caught, but more frequently are found stranded on the shore or floating dead upon the surface. Mattak is the Esquimaux's choicest dainty. It consists of the skin of a whale either grilled or raw, and has a medical as well as a gastronomic value, being considered one of the best cures for scurvy. Sea-fowl and fish, and the eggs of the eider ducks, add largely to the Greenlander's larder, which unfortunately too often "gives out" during the long winter. For the information of the curious, a well-informed writer has given an authentic menu of an extraordinarily sumptuous feast at a wealthy Esquimaux's house. It was as follows:—Smoked seal-flesh; cooked do.; half-raw, half-rotten do. (the so-called Mikiak). Roasted elk. A piece of a whale's tail. Roasted reindeer. Smoked salmon.

Smoked reindeer. Cranberries mixed with entrails of reindeer. Cranberries preserved in fat. Of all the dishes which the Esquimaux eat with a relish none is more revolting to our idea than the half-digested herbs which they find in the paunch of the slaughtered reindeer; yet so highly do they esteem this nauseous fare that they call it Nerukak, the "food of foods." The physiological explanation of the loathsome taste is the craving of the human stomach—a craving which will not be refused—for vegetables of some kind.

In addition to the reindeer, the Laplanders feast on bears' flesh and birds. The stalks of the plant Angelican affords them a favourite dish, and the plant is looked upon in Norway as a preservative from scorbutic complaints. In extremities the Lapps boil the moss that hangs down from the trees and make gruel. Berries of every description abound, and supply the place of fruit in the summer. "In order to tickle the palate they peel the rind from the fir-trees, and eat it either raw or smoke-dried, or, in order to make it thoroughly appetizing, they dip it in their favourite sauce, fish-oil." Salmon is the premier dish among the residents by the sea. It is eaten uncooked, but dipped in fish-oil, and the tiniest babies are given this dish to accustom them to oil. The store of dried fish sometimes becomes exhausted, and then the refuse heads and bones are all collected on which there is a little flesh to be found; they are put into a cauldron together with slices of seal fat, previously preserved in the seal's stomach, and the whole concoction is boiled together. On the whole, the Laplanders' food is wholesome and nourishing. They are enabled by it to endure the fatigues of their inhospitable life and the severity of their rigorous climate. Besides being nourishing, their diet is conducive to health, and it is said that the Laplanders suffer in consequence very little from disease. Fevers, plagues, and other epidemics are practically unknown among them, except colic with spasms, which prevail somewhat extensively. They drink water, and brandy is their nectar. A peculiarity of the Lapps' culinary arrangements is that the men do everything but clean the utensils, which the women do by licking them!

A favourite dish with the Bachirs who inhabit the Uralian regions of European Russia is thus described: A sheep is boiled whole and then cut into pieces, both the flesh and the fat being chopped very small. Meal is then freely mixed with it, and it is boiled over again into a kind of broth, very thick of course, which is eaten with the fingers; a leathern bottleful of koumiss then goes the round of the festive board. Mare's milk (which koumiss really is) has the property of undergoing a slight spirituous fermentation, especially when, after being submitted to heat for a little time, it is shaken up for a considerable period. It has an intoxicating effect, though the taste of alcohol is covered by its acridness. It is considered salutary for phthisis, and it often restores the vital forces to persons in the last stage of exhaustion. Koumiss is more a necessary of life to the nomadic Bachirs; the sedentary Bachirs, on the other hand, habitually eat bread, with beef, mutton, or horseflesh, and are only incidentally addicted to koumiss. They have, however, borrowed a spirit (*kvas*) from the Russians, and prepare it like them from meal and bran.

To travel from the Northern to Southern latitudes, we find most peculiar food customs among the peoples of the Makassar, Javanese and Papuan races, which make up the population of the Dutch island of Amboina—a land of plenty, and yet whose resources are so little taken advantage of. The staple food of the

Amboinese is sago, prepared in a variety of ways, from the simple blanc-mange shape to preparations of it seasoned with spices and flowers. Sago pap is to them a delicacy, and occupies the position in their diet that macaroni does with the Neapolitans. Bread is very dear, and in consequence is beyond the means of the aboriginal population. Vegetables are more plentiful than meat; no considerable quantity of fish is eaten, which is somewhat remarkable considering that the coasts and creeks of the island are the resort of all varieties. No one seems to think of attempting to catch the fish, which are close at hand in shoals. Birds are seldom eaten; the use of mushrooms is altogether unknown. The drinking water is of the best quality, though to those who first visit the island it tastes insipid, and has a chalky flavour. Our authority records further that "Anak has been introduced by the Chinese, who have increased its stupefying effects by mixing it with various vegetable products. This spirit, the effects of which upon the aborigines have been deplorable, has found its way to the hut of the poorest native. But their favourite beverage nevertheless is the bitter sageroe. The natural sap of the sago plant is called sweet sageroe, but it rapidly becomes unfit for drink, and is therefore promptly converted into bitter sageroe by means of 'sebat segero,' the root of the kayoe toenie. What brandy is to the Russians, sageroe is to the inhabitant of this island, be he planter, labourer, citizen, ferryman, Mahommedan or Christian. It is the same drama with different actors, the same spring at which the drunkard refreshes himself; the same fruitful source of misery and crime." One peculiar feature of the Amboinese is the extensive use of so-called edible earths, which are largely eaten by the women when in an advanced state of pregnancy, the poor creatures being credulous enough to believe that by this means they will bring white children into the world. Boiled rice is the staple food of the Javanese, but they enjoy a quantity of other dishes made up of fish; flesh and fish mixed together, the fat larvæ of a very large beetle which lives in the palm and cocoa-nut plantations, and is considered a very great delicacy; ducks' eggs, baked ants, &c.; nearly 400 kinds of their fresh-water fish are edible, and there are no fewer than 1,100 kinds of salt-water fish, most of which can be eaten also. Although rice, as we have said, is the staple food, yet it has many competitors in the vegetable kingdom, including maize, wheat, the pulse of Java, sweet potatoes, and especially a variety of the cassava or maniok, so well known in the West Indies, which it is stated far surpasses rue as an article of food, and can be cultivated with much greater ease and far less watching. Unluckily, in the eyes of a Javanese native there is nothing in the world equal to rice; and though he may have already partaken of many much more nutritious foods, he does not regard his meal as complete till he has also consumed a quantity of rice.

The diet of the inhabitants of modern Egypt and the Nile valley does not embrace a great variety of meats. The consumption of butchers' meat is mostly restricted to mutton, and that only in small quantity. The flesh of the camel is eaten only by the peasants and the desert Arabs, being unlawful for the Copts. Buffalo meat is tough, coarse, and seldom consumed. Pigeons and poultry are reared everywhere, and quails and partridges occur wild. Fish figures largely in the maritime and fluviatile districts. The salt fish is prepared after the manner of cod; the smoked fish by the method adopted with herring. An important item in the piscatorial harvest is "bontarge," a kind of caviare prepared from the roes contained in the two oblong membranous pouches in the mullets common to Lake Menzaleh. In Upper Egypt crocodiles are taken in the Nile by means of traps, or by harpoons fixed in hollow bamboo handles, and secured by a cord which unwinds with the struggle of the wounded beast. Honey is obtained from domesticated bees, and is generally clarified before being eaten.

In reference to ourselves, the peculiarities of our dietary do not seem so much marked as is the case with foreign and semi-barbarous people. We imagine we have a more rational diet, and we hope that we benefit greatly, and endeavour to prolong our lives by observing, to some extent at least, the canons of health so numerously laid down by the medical faculty, and those food reformers who would have man to thrive and labour on the humble sixpence per diem. Both sections of the community—the medical men and the reformers—are agreed upon the possibility of keeping up health and strength beyond the allotted span of life upon an expenditure even lower than that we have named; but, generally speaking, the true philosophy teaches us that our bodies are living machines of a very complex character. Chemically, although we may consist, each of us, of some two-thirds by weight of water, yet the remaining third of solid materials exhibits in its way many intricacies of composition. We are made not of one or two but of divers stuffs. Complex compounds of a highly vital character commingle with minerals and with simpler materials to build up our frame. Nor is this the whole story of food and its nature in relation to the body demanding to be nourished. We must find in the food the elements of the body, it is true, which is the common-sense basis of all nourishment. If food is to replace and repair the bodily wear and tear, without which not even so light a work as the winking of the eyelid can be performed, it is clear above all things else that in our nourishment we should expect to discover the substances of which our frames are built up. The New Zealand native had a ferocious way of gouging out his sharp-sighted enemy's eye and swallowing it, because he thought that such an act would give him the clear sight that resided in that eye. Dr. Blythe, in his "Diet in Relation to Health and Work," remarks that a very similar popular view is held by many people in reference to food—they think, if you want muscle, you must eat muscle, that fat makes fat, and that mineral matters make bone; but in these popular notions there are many errors which Dr. Blythe proceeds to clear up.

Foods are scientifically divided into (1) Water, (2) Meaty or albuminous substances, (3) Starches or Carbohydrates, (4) Fats, (5) Mineral matters, (6) Accessory foods, all of which have representatives in the body itself. The amount of water in food, as in our bodies, is very large. A beefsteak contains 75 per cent. of it; cabbages 85 to 90 per cent.; and of substances most commonly eaten, rusks or biscuits are the driest, and water-melons the most watery of food. Water builds up new tissues, and from innumerable experiments, many, as in cases of shipwrecked persons, unfortunately compulsory, it has been abundantly proved how long life will last with only this element to sustain it. The amount of water, in every shape, which Dr. Blythe allows to be sufficient, is a daily total of four and a half pints. In the second division, the four chief carbohydrates are ordinary cane-sugar, glucose, and starches, such as wheat starch in bread, oat starch in oatmeal, rice starch in rice, &c., and they are transformed, in the mouth, in the stomach, and in the intestines. Fat is not formed entirely from fat, but in part from carbohydrates, and in part from meaty substances as well. Albuminous food, besides containing carbon, oxygen, hydrogen, and a little sulphur, also contains nitrogen, and, as is well known, all the important functions of the body are carried on by nitrogenous foods, and solids—that "each person from the beginning to the end of existence is immersed in a great gaseous ocean of nitrogen." A meat diet increases tissue change. Salt is the only mineral matter that man craves for—all the rest being taken in sufficient quantities with our daily food—and the explanation of this common desire for salt is to be found in the fact that it is essential to all the fluids of the body, the blood, the lymph, and the chyle. Accessory foods are the luxuries of diet, such as tea, coffee, alcoholic drinks, and spices.

The English are essentially a meat-eating nation; we eat more meat than any of the European peoples, and under these circumstances it is of interest to know something of the differences in the flesh of various animals. From elaborate researches Messrs. Lawes and Gilbert have compiled numerous analyses of the variations of the main constituents in different animals. It is clear that if fat-free muscle is alone considered, we buy more in an equal weight of veal than in beef, and that in an equal weight of fat beef there is more muscle than in lean mutton; and if we subtract the water, considering the water as of no value, then the following will be the order of merit: fat pork, fat mutton, fat beef, fat lamb, lean mutton, and fat veal—fat pork containing least water, and fat veal most. There is a fraudulent practice reported by the writer already mentioned, prevalent among butchers, of injecting their meat with water. This is done by means of a fine tube, and it is wonderful how much the weight of certain joints, especially pork, may in this way be increased without any very evident alteration in the appearance of the joint. As to the digestibility of meat, there is considerable variation, as shown by a table compiled in a most extraordinary way. A Canadian patient of Dr. Beaumont's suffered from a fistula or wound leading into his stomach, and through this opening the different foods were introduced and withdrawn at pleasure. Thus we know that the most easily digested food is boiled pig's feet, and boiled tripe, each of which takes one hour; that the longest time taken in digestion is by roast pork, viz., five hours and fifteen minutes. Roast goose, sucking pig, and boiled lamb, each occupy two hours and a half; roast beef and boiled mutton three hours, and fried beef, boiled fowls, roast fowls and roast ducks, four hours each. Dr. Blythe points out that this was the time occupied by the Canadian's stomach, adding that "the digestion of various people differs much, but the order in which the meats disappear is probably constant with all people." To many uninitiated it will appear singular that the result of experiments shows that raw meat is much more quickly assimilated than cooked meat. This is explained by the fact that "the application of heat coagulates the albuminous matters in the meat, rendering them denser and harder, and hence not so easily permeated by the digestive fluids. If we could overcome our prejudices in favour of cooked meat and eat raw, the advantage would be more than counterbalanced by the danger of contracting parasitic and other diseases."

Edible fish is divided into two kinds—fat fish, such as salmon, mackerel, eels and herrings; and lean fish, whiting, cod, haddock, sole, plaice and flounders; and tinned meats are considered as an article of nourishment cheaper than butchers' meat.

Following the classification of food adopted in "Diet in Relation to Health and Work," we come to that which from the earliest times, even when its composition was most imperfectly known, has been considered the type of foods—milk. Dr. Blythe enumerates in his work on "Foods, their Composition and Analysis," no less than fifteen constituents in milk; but for the present purpose it is sufficient to consider that it is composed of water, casein, milk-sugar, milk fat (butter), and mineral substances (ash). These different constituents are partly in solution, partly in suspension, and together combine all that is requisite to a perfect diet. Nevertheless, it is an essential "food for babes," inasmuch as with men a large proportion of the solids in milk do not assimilate, but pass away. The public, unfortunately, do not, as a rule, especially in London and other large cities, get the pure milk, as is evident from the fact that in one metropolitan parish alone, notwithstanding that the "Sale of Food and Drugs Act" is in systematic operation, there is yet a loss to the inhabitants, according to the Public Analyst's report, of at least £10,000 a year from the adulteration of milk. The chief merit of butter as an article of food appears to be its digestibility, as it is an open question whether there is any difference of nutritive value between equal weights of carbon in butter, beef, or mutton fat.

As bread is such a cheap and popular item in our dietary, being technically described "as any form of flour made into a paste with water, permeated by the gases of fermentation and baked," it is interesting to know that in no other article of food has there been greater development during the last few years in favour of the consumer. Chemical knowledge has largely contributed to this result, and the greatest advance in the scientific method of making bread was the patent of Dr. Daugleish some years ago. He was the pioneer of the mixing and manufacture by machinery which gives the process the merit of great purity and cleanliness. When we remember that bread is the staple food of Englishmen, it is strange to reflect that there are a number of civilized nations where a large proportion of the peasantry eat little or no bread. Baked loaves of bread are unknown in many parts of South Austria and Italy, and throughout the agricultural districts of Roumania. In the village of Obersteiermark, not very many miles from Vienna, bread is never seen, the staple food being sterz, a kind of porridge made from ground beechnuts, which is taken at breakfast with fresh or curdled milk, at dinner with broth or fried lard, and with milk again for supper. This sterz is also known as heiden, and takes the place of bread not only in Obersteiermark, but in Carynthia, and in many places in the Tyrol. In the north of Italy the peasantry live chiefly on polenta, a porridge made of boiled maize. The polenta, however, is not allowed to granulate like Scotch porridge, or like the Austrian sterz, but is boiled into a solid pudding, which is cut up and portioned out with a string. It is eaten cold as often as hot, and is in every sense the peasant's daily bread. The modern Roumanians are held by many scholars to be descended from a Roman colony—in other words, to be the cousins of the Italians, and, curiously enough, a variation of the polenta, called mamaliga, is the national dish of Roumania. The mamaliga is like the polenta, in that it is made of boiled maize, but it is unlike the latter in one important respect—the grains are not allowed to settle into a solid mass, but are kept distinct after the fashion of oatmeal porridge.

Oatmeal, barleymeal, and ryemeal are important food constituents, especially the first named, which possesses all the elements necessary for the maintenance of high bodily vigour, and is capable, with the addition of fat, to sustain and support life indefinitely. In the twelfth and thirteenth centuries a bag of oatmeal was the sole provision carried by the Scotch in the border forays, and its more popular form is porridge. At one time barley bread largely supplanted wheaten bread in England, and ryemeal was once a common article of diet. Dr. Blythe mentions a singular feature in the growth of the latter. The rye is subject to a peculiar fungus, which has powerful medicinal properties, and when thus affected, if made up into bread, it causes a very extraordinary disease known as Ergotism, in which mortification of the limbs may take place. Various epidemics of this disease have occurred, but the general disuse of rye-bread in this country has practically extinguished the disease here, though cases are not infrequent on the Continent.

Indian corn is another cereal of marvellous nutrition. "There are few plants," says Dr. Asa Gray, "of which the uses are more various to man, and few which are of greater importance to him than 'zea mays,' called in the United States by the generic name of 'corn,' and in Europe and Asia called 'Indian corn,' or 'maize.'" It is a native of the equatorial regions of Central America, where it was cultivated by the aborigines long before Columbus made his celebrated voyage across the stormy Atlantic and discovered a New World. Yet although there is nowhere an American but believes that corn or maize is one of the grandest products of his native country, there are not wanting naturalists to maintain that the "corn in Egypt" spoken of in the Old Testament was none other than the "zea mays" which supports so many millions of human beings, of horses, cattle, pigs and poultry in the United States and the Dominion of Canada. It is therefore probably indigenous to the Eastern, no less than to the Western Hemisphere, as representations of the plant appear in Chinese books of a very early date, and there are evidences to show that it was brought from Asia Minor to Athens and Rome before the Christian era. Of all cereals it is immeasurably the most productive, as it has been computed that in sunny countries one single grain of maize planted in a favourable position, where it cannot be interfered with or overshadowed by trees, will be multiplied eight hundredfold at the end of three months. How much it has contributed to the wealth and prosperity of North, Central and South America, it would be impossible to estimate. There is no more magnificent spectacle of its kind in the world than that afforded by a field of maize in the month of September over a vast portion of the North American continent. It is, however, in the Southern States of the Union that maize is chiefly valued and most universally employed as a constituent of human food. The negro race, for example, will use no other grain for making bread and cakes, and until an Englishman has partaken of breakfast in Virginia, the Carolinas, Georgia, and Alabama, he can form no conception of the endless array of hoe cakes, Johnny cakes, pone bread, puffs, and much that will be set before him. Of puddings and pastry made from the same rich and unctuous meal there is absolutely no end, while the eagerness and gusto with which delicate American ladies will gnaw the green or immature cobs of corn, which they take between their dainty fingers, should be seen to be understood. The pith of the culm before the flowers are produced, abounds in a sweet oily juice which is boiled into an excellent syrup, and, fermented and distilled, it yields a rich spirituous liquor. The dried leaves are used as a winter fodder, and in recent times they have been subjected, while yet full of sap and juice, to pressure in a pit, and form the best materials for what is known as ensilage. The stalks again are employed for thatch and for fuel, and also for making baskets; and from the cobs or husks from which the grains have been removed a pipe is constructed, which every Southern farmer and every adult male negro uses for smoking tobacco. The silky spathes or swaddles surrounding the ear are utilized in a variety of ways; in fact there does not appear to be a particle of the plant that is not laid under some service in its native lands. When the Irish potato famine was raging in the winter of 1845-46, the American Government chartered a vessel which they loaded with maize, and sent it over as a present to the starving human beings who were perishing of hunger in the southern and western counties of Ireland; but the generosity was thrown away. Rather than eat maize in the form of bread and cakes the Irish poor prepared to starve for want of the less sustaining potato. The late Sir Charles Trevelyan, who devoted himself with rare unselfishness and energy to visiting Tipperary, Galway and County Cork, reported that he had in vain attempted to teach Irishwomen how to cook maize in any of the multitudinous forms which it assumes when dressed for the table in China, Asia, Africa and America.

By a continuity of narrative we now approach the subject of the potato, which has had its centenary praises sung, and which remains an important dietetic entity upon every dinner-table in Europe. It is, moreover, the staple food of a vast population under British dominion. There are differences of opinion as to how the plant became naturalized in Europe: England gives the honour to Sir Walter Raleigh, of having first brought it over to this country; Germany, or at least parts of it, accord the honour to Sir Francis Drake; while France regard their own Parmentier as entitled to most credit in the matter. In England, however, the potato was known in 1586; in Spain it had been introduced even earlier, brought there by enterprising navigators, and invaders from the southern part of the American continent, as Raleigh had brought it from the north. Strange, that neither from Spain nor England had it made its way into France, and that, to enrich his country with it, Parmentier had first to march to Hanover, to be made a prisoner there, and detained until he had been able to familiarize himself with the method of cultivating it, and the various modes of preparing it for the table. When, however, the French had once got hold of the potato they certainly showed that they knew what to do with it. Potato-sugar and potato spirit apart, they invented some half-dozen modes of cooking it which have since been adopted in all civilized countries. It was reserved for the French to teach us how to fry potatoes in two or three different ways; how to stew or "Sauter" them; how to arrange them in little round pieces, well browned and with fried onions *à la Lyonaise*—or sliced, boiled and covered with parsley and butter *à la maître d'hôtel*. Doubtless, but for Parmentier and the French, says an authority on the subject, we should at this moment in England have only four ways of serving up potatoes—boiled, mashed, baked, or roasted. In whatever form, however, the potato is the cheapest vegetable diet obtainable; it possesses antiscorbutic properties, and if supplemented with a little fat, or, still better, with fat meat such as bacon, it will support life and maintain health for an indefinite time. Half a pound of bacon and five pounds of potatoes are given as a daily diet upon which a labourer could do hard work, and live in good health. Beans, peas, and lentils succeed the potato, and the importance of cabbages, carrots, turnips, &c., is far more than their nutritive value, for without the addition of these substances, even while eating fresh meat, we are liable to decline in health and suffer from eruptions, while if we eat salt meat for any time, and consume neither potatoes nor vegetables, nor fruits, then that terrible disease scurvy is imminent.

Fruit has now a large part in our modern dietary system, and if we accept the teaching of Dr. De Lacy Evans, who has added to the already voluminous literature on "How to Prolong Life," man may live entirely upon fruits in better health than the majority of mankind now enjoy. "Good, sound, ripe fruits," he says, "are never a cause of disease, but the vegetable acids lower the temperature of the body, decrease the process of combustion or oxidation—therefore the waste of the system—less sleep is required, activity is increased, fatigue or thirst hardly experienced." Still the body is well nourished, and as a comparatively small quantity of earthy salts are taken into the system, the cause of old age is in some degree removed, the effect is delayed, and life is prolonged to a period far beyond our "three score years and ten." Dr. De Lacy Evans himself proved the fact that a fruit diet requires less sleep. He lived for five days entirely upon oranges, with the result that the temperature was lessened, though there was a pleasant glow through the whole system. To other individuals, however, he felt cold, so that animal heat is only relative. Only three or four hours' sleep was required in the twenty-four.

Fruits, he maintains, are nutritious in themselves, but should they not contain sufficient nitrogen to satisfy a theoretical appetite, all the other elements being present, man may absorb the deficient nitrogen from the surrounding atmosphere, the combination resulting in albumen or protein. "For this reason, together with the fact that they contain little earthy matter, fruits are man's best diet, if truly he desires a long life." Dr. De Lacy Evans recognizes the difficulty attending a sudden change of diet, and the necessity of conforming to the rules and usages of society, and therefore lays down the following simple rules :—(1) Eat moderately, always remembering that you eat to live—to give a balance to the system. (2) Take no more than three meals a day. (3) Avoid eating large quantities of bread, pastry, and other farinaceous foods. To those who are willing to make alterations in their diet, he would apply the same rules, with this difference :—Eat fruits, if possible, at every meal, and commence with them ; if the appetite is not moderately satisfied, finish with the ordinary articles of diet.

A few years ago a diet like that above recommended would have been impossible in the majority of households, but the development during the last few years of the import trade in fruit, and the impetus given to it by the Colonial and Indian Exhibition, has brought this dietetic element within reach of all, in some form or other. The West Indies, probably more than any other part of the globe, have enlarged the export of fruits. They grow almost wild, and include bananas, pineapples, plantains, cocoa-nuts, prickly pears, the bread fruit, &c. Not all the West Indian fruit is suitable for export here, but most of it is, and the trade is rapidly assuming large proportions. The Colonies, too, supply the English market with a remarkable variety of fine fruit in different systems of preservation, none of which are prejudicial to the fruit itself.

The subject of drink in relation to diet has given rise to much controversy. The art of making strong drinks, not only to exhilarate, but to intoxicate, seems to have been one of the earliest attainments of our race. In all parts of the world, and in the rudest states of society, mixtures of such a kind have been discovered. The infusion of herbs into the fermentation of so-called cordials must have been practised in the most early ages, and it is somewhat noticeable that the Gaelic word *lusadh*, which means drinking, is derived from *lus*, a herb or plant. The Celtibri had at their festivals a certain liquor composed of no fewer than one hundred kinds of herbs, and which was esteemed a most sweet and wholesome drink. Others at a very early age were fond of distilling various flowers and herbs to form a mixture, special care being taken to gather them at a certain age of the moon. Before wine became a drink among the nations of Western Europe they employed not a little of their grain in making two kinds of drink called *curmi* and *zythus* (corresponding to our ales and beer), by simply steeping it in water. Whether the Caledonians could make malt liquor as early as it was found in use among the South Britons, is not known, but curmi or ale was in use in the third century, and common in the sixth. The Picts were noted for the art of extracting a delicious drink from heather tops and blossoms. A pleasant drink, it is said, is often made from the flowers of the heather, differing from the Pictish beverage in the addition of other ingredients, and especially honey. Herb ale was a favourite "browst" in the olden time, and it was an invariable practice when brewing to put a quantity of blooming heather tops in the mash-tub, which gave a peculiar strength and flavour to the liquor. The roots also were sometimes used, but from their astringent nature they had to be used sparingly. It is said, however, that beer equal to the best malt liquor could be made from herbs furnished from the Scottish mountains. We have, therefore, a continuous history from earliest times to the present day of the manufacture and consumption of an intoxicating drink similar to the popular beverage of the English people; and notwithstanding all the literature to the contrary, there is yet no evidence to show that alcohol in moderation, and judiciously used, is detrimental to health. Total abstainers should not forget that alcohol is formed in their own bodies, and, as Dr. Richardson says, "No man can be, in a strict scientific sense, a non-alcoholic, inasmuch as, 'will he, nill he,' he brews in his own economy a 'wee drap.' It is an innocent brew certainly, but it is brewed, and the most ardent abstainers must excuse it. The fault, if it be one, rests with Nature, who, according to our poor estimates, is no more faultless than the rest of her sex." Smoking likewise, in excess, is injurious. It affects the brain, the heart, the circulation and temperature; but it is to a certain extent a disinfectant; it mitigates the pangs of hunger, and soothes depression.

Dr. De Lacy Evans has brought together a very curious and entertaining list of cases of longevity, and his first instance is remarkable, and only one among many similar ones supporting the fruit diet. A lady at Cowes, in the Isle of Wight, died in 1754, at the age of 108, having lived upon biscuit and apples, with milk and water during the last sixty years of her life. Extreme temperance is the characteristic of most of the cases, and the diet was mainly milk, vegetables, fruit, &c. One venerable instance is that of Petralsch Zartan, a member of the Greek Church, who is said to have lived to the age of 185. He was a strict observer of the numerous fasts established by the ritual of his religion, but added to his abstemious diet (milk and leaven cakes) a good-sized glass of brandy. There are a number of instances recorded where "moderation and temperance may have been practised in diet, but not in alcoholic drinks and tobacco." A certain Daniel Bull McCarthy, who lived to the age of 111, in the county of Kerry, "when in company, for the last seventy years of his life drank plentifully of rum and brandy; and if, in compliance with solicitations, he drank claret or punch, he always drank an equal quantity of rum or brandy, which he called a 'wedge.'" A Middlesex veteran who survived beyond a century, actually never took any other liquids, as liquids, into his stomach than ardent spirits—London gin. Until within a fortnight of his death he took from a pint to a pint and a half daily. Leeds was the residence two or three years ago of a woman of some celebrity, who when last she appeared before the magistrates and was getting on to ninety years of age, gave a story of her life, which was one of habitual intoxication. A Herefordshire man who lived to be 108 years old was an inveterate smoker, taking his last whiff a few hours before his death. Dr. De Lacy Evans sees a philosophy in such cases. "Both drinking and smoking take away the appetite; less food is eaten, therefore a less amount of earthy salts are taken into the system, and the cause of old age is delayed in its results; still sufficient food is taken to support life, and great age follows." Among other instances of longevity must be mentioned the celebrated Thomas Parr, who died in 1635, aged 152. He married at the age of eighty-eight, and would appear to owe his death to the interruption of his regular and abstemious mode of life. He was brought to London by Thomas, then Earl of Arundel, to see Charles I., "when he fed high, drank plentifully of wines, by which his body was overcharged, his lungs obstructed, and the habit of the whole body quite disordered; in consequence, there could not be but speedy dissolution. If he had not changed his diet, he might have lived many years longer." A Yorkshireman who died in 1670, aged 169, remembered the battle of Flodden Field, and the registers of the Chancery and other courts proved that he gave evidence and had an oath administered to him 140 years before his death. When ninety years of age, a child was born to him, and when 160, he walked to London to have an audience with Charles II., and was able to swim across rapid rivers after he was 100. His diet was coarse and sour.

There have been during the last two centuries numerous voluntary exhibitions of fasting to test the tenacity of life to the human body, and the most recent instances, those of Merlatti, Succi, and others, at the close of 1886, and the beginning of 1887, aroused fresh attention to the subject. Dr. Forbes Winslow has related a few facts not previously generally known in reference to fasting. That life can be supported and preserved, and the ordinary duties performed on a diet comparatively simple and limited in amount we have already shown, but Dr. Winslow's evidences of fasting, both voluntary and otherwise, form an interesting supplement. In 1719 there lived a certain Thomas Wood, born of intemperate parents. Up to the age of forty he indulged himself to excess in meat of a fatty nature, and in large quantities of those articles of diet containing fatty ingredients, such as cheese, butter, and sugar, his beverage being strong ale. He gradually developed into a man of enormous dimensions, and complication after complication of disorders arising day by day, he became alarmed at the inevitable fate which stared him in the face. He gradually cut down his diet by degrees, diminishing his beer to begin with, and then those diets containing sugar, and also animal flesh. He ultimately allowed himself only pudding made of sea biscuit. With this change of food all his symptoms disappeared, he became metamorphosed from a monster into a man once again. The curious fact is that he abstained from all drink of whatever description. The "sea pudding" was composed as follows:—Three pints of skimmed milk, this, being boiled, was poured on one pound of sea biscuit broken into pieces. This compound being boiled in a cloth for two hours, it became a pudding of sufficient consistency to be cut with a knife, and on this alone he subsisted for two years, enjoying splendid health, and with an absence of all those disagreeable symptoms before mentioned. The quantity taken was $1\frac{1}{2}$ lb. at five o'clock in the morning as his breakfast, and the same quantity at noon for dinner; after this hour he abstained from all food until next day. The case of Wood is beyond all doubt, as two clergymen, two doctors, and the churchwarden in the parish where he lived all testified to the truth of the facts.

Continuing to trace the history up of fasters we come upon that of John Brown, a miner, of Ayrshire. He lived buried in a coal mine without swallowing anything but small quantities of chalybeate water sucked through a straw, this being sufficient to sustain life even in a contaminated atmosphere, the nervous excitability being thus diminished, and thus mitigating the cravings of hunger. At Liège some colliers were shut up in a pit for twenty-four days, and sustained their lives with water alone from a fountain. Experiments were made and the water analyzed. It was found to contain upon evaporation nothing extraordinary, and only lime, or what is called "calx." The same constituent is supposed to have existed in the fluid which supported John Brown, as before alluded to. Elizabeth Woodcock, in 1799, lived eight days on snow-water. Cecilia Steers, in 1820, lived fifteen days also on snow-water alone. This came from a well thirty feet deep, and which had been made for the purpose of obtaining chalk. In 1765 we read of three women in Italy, buried for thirty-seven days in the snow, living on snow-water, also impregnated with lime. In 1795 a Yorkshire gentleman, aged sixty, absolutely was incapacitated from taking food for thirty-six days. When in health he weighed 240 lbs., and on the thirty-second day of his fast he was reduced to 138 lbs. in weight. Dr. Willan relates a case of an abstainer living seventy-two days without nourishment, on which day he died exhausted. He lived only on water flavoured with orange-juice. Henry Welby, who lived in 1637, never tasted either fish, flesh, or fowl for forty years, though possessed of great wealth. He died at the ripe old age of eighty-four. During the whole of his retirement his chief food was oatmeal gruel and salad of cool herbs. But the longest time recorded in the annals of physic in which a man existed without food was sixty-one days, the case being that of a young man driven mad from overwork. Alexander Benedictus mentions a case at Venice where a man lived forty-six days without food. The History of France states that Louis the Pious, Emperor of France, who died in 840, existed forty days without food or drink. Albertus Magnus gives us the record of a woman of Cologne who lived for seven weeks only on water. It is said that Democritus lived to the age of one hundred and nine years, and that in the latter part of his life, for forty days, he lived on smelling honey and hot bread. Raulin relates another case where fifty-two days of fasting took place on water alone. The *Medical Gazette* for July 1833 contains two remarkable instances : one of these, a patient, is stated to have lived six years without swallowing any food, the mouth being occasionally moistened with water, tea, or whey, which was not swallowed but spat out. In the other case, which was originally recorded by Professor Ricci, of Turin, an inability to take food existed for three years. There are many traditions in all histories relating to the means employed by various individuals to support life during danger and privation. The Indians of Asia and America, when they are bound for a long journey where there is a possibility of such a state of affairs existing, prepare themselves for emergencies as follows: They mix the juice of tobacco with powdered shells in the form of small balls, which they retain in their mouths. The gradual solution serves to counteract the uneasy craving for food, it having been proved by experiment that clay introduced into the stomach relieves hunger. In 1770, a woman living at Barmouth created considerable excitement and amazement in the world. She was reported to have lived for seven years and a half without tasting food, her lips only moistened with water.

The manuscript department at the British Museum contains a quaint description of the fasting of Jane Hodges (Sloane MS., 4,811). She lived in the year 1669. She suffered from hysterical aphonia, and neither ate nor drank for nine weeks, so it is reported. She was under a delusion, and stated that "she fasted for the sins of the people, and that she was the saviour of the nations." She ultimately recovered and took food. In 1870 we read of the "Lancashire fasting girl," Ellen Sudworth, aged eleven. This is, however, not one of clear abstaining from solid food, as she lived on liquids and soups. We now come to Dr. Tanner, the American physician, who in 1880 commenced his fast of forty days' duration. He apparently completed this, and was stated to have benefited to the extent of £25,000 by it as a commercial speculation. This "fasting doctor" has been followed by innumerable imitators. One student, an Italian, who attempted to exist for fifteen days without food, succumbed on the eighth day, and in other cases death has proved the impossibility of the task, except to such as are physically constituted to resist privation for a lengthened period.

A remarkable fasting incident was reported from America in October, 1886, at the time Merlatti was beginning his feat in Paris. It was the case of Anabel Langan, a Wisconsin girl, nine years of age, of whom her mother gave the following account:—Last January Anabel began to lose appetite, and gradually discarded the use of food. At first she gave up tea and coffee; then she stopped eating meat and vegetables; and finally milk and fruit were discarded. During her long fast she virtually lived on air. She drank water in great quantities, and inhaled the atmosphere with much satisfaction. She became dreamy and slightly preoccupied, but did not decline in health. Her cheeks became more pale, but she was not reduced in weight to any extent. She delighted to roam in the open air, and always returned from a ride as gay as a lark. She had such a longing for the fields and woods that it was a trial to her when night came. To people who saw her, and said she was not well, she would say, "I am all right. I can't die as long as I am not hungry, and I am not hungry yet." She was at this time under the care of Dr. Overpeck. By his direction she was regularly bathed in milk and olive oil. Every device was resorted to to stimulate a taste for food. Dainties were temptingly exposed, but she rejected them all alike. On the fifty-third day she was seen to nibble a crumb of bread. From that time she began to gradually recover her appetite.

Merlatti's self-imposed fast of fifty days, which was to outdo Succi, who had fasted thirty days, came to an end on December 16th, 1886. His condition was flushed and feverish, and perceptibly thinner than formerly, but, on the whole, he was reported to be looking remarkably well. It is noteworthy, however, that, on the thirtieth day of the fast, the Medical Committee broke up, unwilling to incur the responsibility of any accident that might befall the fasting man, who must be taken at his word for having kept on for the remainder of the time, as only a desultory surveillance was maintained. Merlatti served no scientific purpose by his fast; he was in a starving condition when it was over, and was rallied with difficulty.

There are a few articles in our general dietary we have not yet alluded to, such as tea, coffee, cocoa, drinks, foods, &c. They are classified by Dr. Blythe as "accessory foods," and he subsequently treats of the three first named and chocolate as "alkaloid-holding drinks." There is very little nourishment in the ordinary quantities of tea and coffee, but these drinks give in some obscure way energy to brain and nerve, a stimulus distinguished from that of alcohol in being not alone different in kind but also in not being followed by a depression. Cocoa has more nutriment, and may be considered as a drink or a food, or as a combination. Excessive tea or coffee drinking is responsible for dyspepsia in many instances.

It is rather startling to have our faith in beef-tea as a typical animal fluid food so rudely shaken as has been the case during the past year or two. But as a matter of fact it has been scientifically demonstrated that simple infusions, decoctions and extracts of meat have practically no nutritive value. Milk and cereal preparations now take the place in the sick-room and in hospital wards of the old time beef-tea, and not only among physicians, but among the laity it is coming to be understood that the latter cannot fairly be classed among foods. Virchow, the eminent German physiologist, says that "Beef-tea, which is vulgarly supposed to contain nearly all the valuable elements of the meat, is only of value as a condiment. If drunk while warm it is of about the same value as tea or coffee." Dr. Austin Flint, sen., in an address before the New York Medical Association, declared that the valuation set by many persons upon beef-tea or its analogues is a "delusion and a snare, which had led to the loss of many lives from starvation." Professor Williams, in his work on "The Chemistry of Cookery," deprecates it; Dr. Fothergill, in his "Manual of Dietetics," hopes that the "brains have been knocked out of the superstition that beef-tea or any other meat tea is food," and the *Lancet* has written frequently in the same strain. As stimulants, it is admitted, such preparations, like tea and coffee, have a certain value, not to be ignored, and they may be effectively employed in a class of cases for which physicians are wont to prescribe alcoholic beverages. Nutritious and appetizing broths and soups, of beef, mutton, chicken, oysters, &c., are made for the sick; but in the making of them we are advised to bear two or three points in mind. The nutritive value of these articles consists mainly in the milk, powdered bread, baked flour, pearl barley or other grain preparation added to them. The growing recognition of the fact that the old time "extracts" of meat are comparatively valueless as foods, has led to the manufacture of numerous articles combining not only the juices but the nutritious albumen of the meat with cereals, and in some cases with certain ingredients of milk also.

Artificial temperance drinks have no place in dietetics. In too many instances they have been demonstrated to be frauds upon the public, inasmuch as the most seductive of them have been proved to be possessed of more alcohol than our national beverage itself. Undetected, the frauds have resulted in some unaccountable aberrations, as, for instance, the case of the worthy deacon in the Midlands, who, overpowered with thirst begotten of his exertions in amusing the school children in the woods, drained several bottles of the temperance champagne in the course of the afternoon. Presently an agreeable feeling crept over him, a strange sense of exhilaration caused him to leap about the ground, then sit down on a veal-and-ham pie, and finally, like Mr. Stiggins, at the memorable gathering of the Brick Lane Branch of the Grand Junction Ebenezer Temperance Society, accused the whole party of being tipsy!

Frauds in the matter of food were to some extent dealt with in the "Sale of Food and Drugs Act;" although in a sense the measure has proved a failure, as instanced earlier in this chapter with regard to the adulteration of milk. The failure is mainly due to a radically false idea of its conception. The onus of working it falls upon those whom it was intended to protect; it is laid upon the analyst to discover, when it should have been imposed upon the trader to declare. There inheres in a large number of commodities a normal or national standard with which they are as naturally supposed by the public to substantially conform. What is beer? What is butter? What is cheese? No doubt many persons would have to be listened to before these questions could be satisfactorily determined. If after the fullest inquiry it turns out that the legal standard of beer might be reasonably made to cover a certain admixture of sugar, or of malt or hop "substitutes," well and good. If the standards of butter and cheese can be legitimately made to countenance any portion of milk or cream substitutes, so let it be ordained. Then the law should enforce either a compliance with the standard, or a compulsory declaration by the manufacturer of any departure from it. So far as butter is concerned, additional protection to the public has been secured by the Margarine Bill passed in the last session of Parliament (1887), and which is operative from the 1st of January, 1888. It is designed to prevent the foisting upon the public of a substance, the consumption of which has wonderfully increased in late years, and hitherto denominated "butterine." The restrictions imposed by the Act in question are exceedingly stringent, but not more so than on the Continent. Danish legislation, for instance, is very severe under this head. Every keg containing butterine is required to be made of a different shape to that used for true butter, while the legend "Margarine" is indelibly stamped on the receptacles in question. In Austria, fine and imprisonment await the vendor of animal fats who sells butterine without declaring its true nature. In Belgium, the words "artificial butter" are required to be legibly displayed wherever the compounds are sold, and what was regarded as a piece of plain and necessary protections against fraud on the Continent cannot be considered out of place in England. The public have an indefeasible right to know what it is they are buying, and such a system need not in the least degree operate as an abridgment of real freedom of trade. At the same time it is satisfactory to know from specialists and public analysts that "Margarine," which butterine must henceforth be called, is a decidedly wholesome article of food.

To sum up a somewhat complex subject, we may adopt the conclusions of Dr. Blythe, as well as some of those of "A Layman," whose article we referred to at the outset of the chapter. There are diets suited to every age, every climate, and for every species of work, physical or mental; diets by which diseases may be prevented and cured—diets suited to some constitutions and injurious to others—diets which make the skin glossy, the frame vigorous, and the spirits joyous; others which mar the face with wrinkles, speckle the body with eruptions, and make the form hollow and lean and prematurely old. Dr. Blythe thinks that, when by successive researches the science of diet is better understood, without doubt a school of physicians will arise, discarding all drugs, and treating maladies by cutting off certain food, by surfeiting with others—if indeed, at the present time, there is not in the highest representatives of modern medicine the nucleus of the future school of dietetics ready formed.

Our lay writer believes that a man must be his best physician. The inevitable can only be deferred by the hoarding of his strength and health, and this he will most surely do by the observance of one simple rule, framed for man's conduct thousands of years before our wisdom discovered that the pancreatic juice converts starch into sugar, and that levulose is isomeric with glucose—that is the rule of simple moderation.

CHAPTER XXII.

SOME CURIOSITIES OF SURGERY.

As distinct from medicine, the sphere of surgery is more limited, embracing all those diseases which affect the solid parts of the human body, and which can in any way be relieved by manual operation. There is a noble roll of British surgeons whose marvellous achievements, particularly in recent years, are the admiration of the world, while the French chirurgical school includes many eminent operators whose names will live even as the name of Hippocrates, who was the first to make surgery a separate study. Surgery is that department of the art of healing which divides tissues or parts improperly united, and unites those which have been divided, when they should remain in union; separates whatever has become dangerous or inconvenient to the patient, removes foreign bodies or parts of the body which from disease or the loss of vitality have become foreign, whenever they exert a hurtful influence on the animal economy; restores to their cavity or replaces in their normal positions portions of the body which have become displaced; checks the loss of blood from wounded or divided blood-vessels; reduces inflammation or removes the purulent or phlegmonous matter which may have been deposited by them; repairs and corrects any deformities and distortions; and effects the replacement of lost tissues. Its means of accomplishing these results are the hand, lint, bandages and apparatus of various kinds, cutting, crushing and probing instruments, catheters, bougies, sounds, forceps, specula, &c., and the various forms of direct and indirect cauteries, both liquid and solid.

Hippocrates, before whose time the history of surgery has no very strong interest, treated several surgical subjects with considerable success; but as it is doubtful whether he ever had an opportunity of actual dissection, except of animals, we must not be surprised that the art did not keep pace with medicine. Nevertheless, he reduced dislocations, and adjusted fractures, used the trephine, applied the forceps in accouchements, made incisions into the kidney for the removal of the calculi, performed amputations, and perforated the cavity of the ribs in empyema and hydrothorax. After Hippocrates, Herophilus and Erasistratus began anatomical investigations under the auspices of Ptolemy Philopater, in whose reign the study of medicine was divided into dietetics, pharmaceutics, and surgery, the last being practised in Egypt by Philoxenes, Georgius, and Sostratus, Heron and the two Appollonii, with Ammonius Alexandrinus, who was distinguished by the name of Lithotomos. The practice of human dissection began about this period, and among the bold operations of Erasistratus were the extirpation of the spleen, and the application of remedies direct to scirrhosities and tumours. To him also belongs the invention and application of the catheter. Pupils of these eminent men invented peculiar bandages, introduced the tourniquet, and other contrivances for reducing dislocations. One of them employed an instrument for lithontriptic purposes. Before the Christian era, too, in Rome, surgery must have made some progress, for Meges, the predecessor of Celsus, had accomplished numerous operations. Celsus, however, was the greatest surgeon of ancient Rome, and flourished at the commencement of the Christian era. Between A.D. 50 and 120 lived Aretæus, the first to use the cantharides blister, Heliodorus, and Rufus the Ephesian, and afterwards Autyllus, who all added to the surgical knowledge of the time, and evolved new views on a variety of subjects, such as the treatment of injuries of the head, the resort to arteriotomy instead of venesection in sudden emergencies of inflammatory action, the radical cure of hydrocite by free incision of the parts, and a more thorough investigation of the diseases of the kidney, &c.

The early Christians were opposed to dissection, and consequently the art of surgery languished in the early days of that era. Aëtius was the most notable surgeon of the dark ages, although Alexander of Tralles, a younger contemporary of Aëtius, wrote treatises on diseases of the eye and fractures, which secured a high meed of praise. A long oblivion almost buried the art after the overthrow of the Roman empire, and with the exception of Paulus Ægineta, in the seventh century, who was a surgeon of eminence and considerable originality, there is scarcely a record of any men of distinction whose efforts could revive the art until it was resuscitated about the year 900, when the Arabians discovered the writings of the ancients, and appropriated them to their own use, "making great additions, which but disgraced the original." To Rhazes, however, must be given the credit at this time of having described for the first time *spina ventoso* and *spina bifida*, cauterized the wounds from the bites of rabid animals, opposed the use of the knife in cancer, except when limited, and when the whole tumour could be removed, and gave a clear and satisfactory description of the treatment of hernia. Aricenna, who died early in the eleventh century, introduced the flexible catheter, and Abucasis, who died early in the following century, introduced an instrument for the cure of *fistula lachrymalis*, invented the probang, and in wounds of the intestine practised union of divided parts of suture with success.

With these, and a few other exceptions, however, the practice of surgery from the eleventh to the sixteenth century was confined, first, to the ignorant priests, and, when they were interdicted from surgical practice by the Edict of the Council of Tours in 1163, to the still more unlearned barbers and farriers, with occasionally a quack strolling over Europe and imposing on the credulity of the superstitious by his surgical rites. It is curious in this connection to find how closely allied barbers were with surgery henceforward until late in the eighteenth century. In the "Memorials of the Craft of Surgery in England," edited by Mr. D'Arcy Power from materials compiled by Dr. John Flint South, we find it recorded that the barbers were practising surgery as a part of their craft as early as the reign of Edward III., though it is not clear how far this practice extended. It is certain, however, that they were desirous of preventing any person using barbery until, as their petition set forth, "they had been found able and skilled in the said art by trial and examination before certain barbers of the City." The petition referred to was presented to the Mayor and Aldermen of London, who gave assent to it, and it was enrolled as an ordinance in the Chamber of London. "The barbers," continues the work already quoted, "although considering surgery as part of their craft, since it was recognized as such by the ordinance of 1375, either failed to prosper in their surgical practice, or found their authority of small avail, in consequence of the existence of surgeons who were not shavers, and over whose actions they had in consequence no control."

Matters did not run smoothly between the shaving and non-shaving sections of surgical professors; the City took the part of the barber-surgeons, who, however, would appear to have been divided against themselves, for they found occasion in 1415 to "tumultuously" report to Thomas Franconer, Mayor, and the Court of Aldermen, that "certain barbers of the City of London, inexperienced in the art of surgery, very frequently take charge of sick and wounded persons with the intent of fraudulently acquiring their goods, whereby the sick were often worse off at their departure than at their incoming, and on account of the unskilfulness of these barbers were oftentimes maimed, to the scandal of the skilled, and the manifest harm of the people of our Lord the King." Masters of the barber-surgeons were thereupon appointed—"the ablest, and wisest and most discreet of all the barbers practising the surgical faculty, to minister what in their opinion was wanting in cases of death and maim." It was not until more than three hundred years later that Parliamentary enactment finally dissolved the "barber-surgeon" alliance.

The appearance of Vesalius revived the science of surgery, which for the first time, and under the self-educated anatomical scientist, Ambroise Paré, was put upon a sound and scientific basis. Paré was body-surgeon to four of the French kings successively, all of whom he followed to the field, and was much esteemed by the soldiers. To him we owe the improvement of the practice of tying the arteries after operations or wounds, instead of cauterizing them with hot irons or boiling oil. Beneficial as this mode of treatment was, it met with most violent opposition from the physicians of the time, who were astonished that a surgeon should dare to publish any plan of treatment not found in the writings of the ancients, and accordingly after his death the use of the ligature declined. Next to Paré in the order of illustrious surgeons followed Fabricius ab Acquapendente of Padua, who published the first really valuable treatise on surgery of modern times, and which passed through seventeen editions. Petit, in the seventeenth century, cultivated anatomical knowledge when a mere boy, and published his treatise on diseases of the bones when a very young man. Holland also possessed a genius in surgery named Raw, who was the most distinguished lithotomist in Europe; but who excited some contempt for concealing his mode of operating even from his pupils, Heister and Albuins, whose merits, however, effaced the stigma of Raw from Holland, as did the conduct of the illustrious Camper in the following century.

In England the practice of surgery dates from the time of Wiseman, who was sergeant-surgeon to Charles II., and was the first eminent writer on the art in this country. He was the father of English, as Paré was of French surgery. He was the first to recommend, what is still the practice, viz., immediate amputation in military emergencies when the preservation of the limb was impossible. The flap operation in amputation is claimed by James Young, and also by two French surgeons, all contemporaries of Wiseman's. Cheselden, White Douglas, the two Monroes, Sharp, Cowper, Warner, Alanson, and Percival Pott (who first gave lectures at St. Bartholomew's Hospital in 1729, and who is well known as the most judicious writer on fractures, amputations, injuries of the head, and diseases of the spine), Hawkins, Smellie, and the two Hunters followed, to make up a famous record. John Hunter was the greatest master of the principles of surgery in the profession. It was he who first pointed out the danger of operating on a diseased artery, and showed how it might be obviated: to him surgery owes the greater part of her scientific reasonings. He was also the best operator of his day, having once removed a tumour from the side of the head and neck as large, if not larger, than the head to which it belonged, and at another time dissected out a tumour which one of our best operators had, too hastily, declared none but a madman would meddle with.

About the same period Germany furnished Hildanus, Scultetus, Puriman, and Heister; Italy, Saliacotius, Cæsar Magatus, and M. A. Severinus; France, La Peyronic, Jean Louis Petit, Ledran, Garangeot, and the illustrious Desault, to swell the ranks of distinguished surgeons, which may be supplemented by the names of Molinelli, Morgagni, Scarpa, Bertrandi, Moscati, Pevender, Plätner, Röederer, Rambilla, Sheden, and Richter.

The nineteenth century has, however, accomplished more in the development and improvement of the science of surgery than all the centuries before it. In England, Home, Abernethy, Sir Astley Cooper, Liston, Lawrence, Guthrie, and others of the highest reputation, have passed away, leaving us others hardly less eminent in the field. In France, Dupuytren, Roux, Lisfranc, and Larrey had no superiors before them, nor had Germany before Richter, or Italy before Scarpa. The accomplishments of the period in which these men reigned over anatomical science are succinctly summed up in Messrs. Ripley and Dana's Cyclopædia:—The introduction of anaesthesia, resection of the bones at the joints, the preservation of the periosteum and consequent development of new bone; partial amputations of the foot, as instanced in the operation of Lisfranc for the removal of the metatarsus, and of Chopart, Symes, Malgaigne and Pirigoff for disarticulation of tarsal bones; the amputations at the thigh and shoulder joints; the ligature of arteries within the trunk and immediately at their departure from it; the resection and removal of portions or even the whole of the upper and lower jaw; the operations for cleft; the opening by longitudinal sections of the air-passages at different points to avoid asphyxia; the introduction of the silver suture, especially in operations on the viscera; the adoption of the immovable apparatus for fractures; the processes for remedying disunited fracture; the substitution of milder means for the trephine in all except the most serious cases; the improved treatment of ulcers and abscesses; the cure of the most formidable aneurism by the ligature of the carotid subclavian, axillary, humeral, and external and internal iliacs; the treatment of varicose veins; the successful treatment of calculus by lithotrity, in consequence of the great improvements made in the processes and instruments; the diagnosis and treatment of tumours, whether encysted, fatty, vascular, or malignant; the cure of strabismus, and the generally improved treatment of diseases of the eye, including the invention of the ophthalmoscope by Helmholtz in 1851, and the reformation of ophthalmic medicine and surgery carried on by Graife, Donders, Bowman, Toynbie, Wilde, Von Tröltsch, Politzer, and others; the restorative processes by which the nose, lip, and other parts are reformed from adjacent tissues; the treatment of harelip and club foot; the notable advance consequent upon the conservative treatment of gunshot and other wounds of the brain, and a host of other more technical achievements.

In most recent years a change came over the practice of surgery because of the influence of the germ theory of disease. The theory was adopted in England, notably by Mr. Lister, and by certain leading German surgeons, including Volkmann, Von Nussbaum and König, though it met with little "honour in its own country"—at all events in France. It was Pasteur's theory, and it consisted of a systematic endeavour to prevent the access of air, and therefore of germs contained in the air, into wounds, and to destroy any germs which might have entered. Carbolic acid was the germicide upon which he placed his main reliance, and all wounds were immersed in it, and all operations were performed in its vapour instead of in the air. The most essential part of every operation became a spray apparatus which should surround the tissues to be operated upon with a vapour of carbolic acid. The surgeon himself, his assistants, the instruments used, everything which could possibly convey a microscopic germ into a wound, was thoroughly impregnated with the germicide, and after this the wound was dressed with absolutely impermeable complicated dressing composed of many layers of different materials, each adding to the wished-for result—the avoidance of the entrance of air. When it became necessary to open a wound that had once been dressed, the same elaborate performance was repeated, and the part could only be inspected and examined under a covering of carbolic acid, either in the form of a solution or a spray. This is what is understood by antiseptic surgery, which has in some degree modified the surgery of the day. The practical details of the treatment have been modified from time to time; other antiseptics, such as the bichloride of mercury, thymol, and eucalyptol have been substituted for carbolic acid, but the essential features of the system remain. Whatever may be the

technical verdict as to the antiseptic treatment, it has the admirable quality of promoting perfect cleanliness, and the prevention in consequence and in some degree of putrefaction ; the avoidance of any collection of pus in wounds by drainage, and of securing absolute rest to injured parts. The extent to which absolute cleanliness may be carried, and the good results of such care, are shown in Volkmann's clinic, and the following description must interest all who are unacquainted with the organization of such an establishment :—
"Since 1873 every nurse and assistant has submitted to careful disinfection before touching any breach of surface, no matter how trifling. All sounds used for exploration, and even scissors used for cutting sutures in wounds not treated antiseptically, are first disinfected. During this period the slighter forms of phlegmon have entirely ceased, and erysipelas is only rarely seen in its so-called spontaneous form. Visitors going through his (Volkmann's) wards and seeing recent wounds on the face treated by the open method, without any inflammatory action being visible, have remarked that the wards must be so entirely carbolized that all wounds heal readily ; or that such cases show what good results may be obtained by the old method. Both conclusions are incorrect, for all the cases were treated on the antiseptic plan, the occlusion dressing alone being omitted. In every case, in every part of every operation, the causes of putrefaction are excluded. So thoroughly are his best nurses imbued with this idea that they disinfect the scissors with which they cut off the plaster bandage from a simple fracture. His own practice is to use a five per cent. solution of carbolic acid freely for washing. He does not consider it necessary to go to the extent of changing the linen ; but for operations and dressings both

he and his assistants put on white linen coats, and of these he often uses three or four for himself of a morning. He discards the old cloth operating gowns, and does not approve of the waterproof sleeves and aprons. By this means he is enabled to deliver his course on operative surgery from six to eight o'clock in the morning, during which his hands are constantly in the blood and fluids of fresh and putrid subjects, and then occupy himself immediately with operations on the living, and with fresh wounds, without carrying infection. He thinks it much better to disinfect a visitor and to dress him in a fresh clean gown than to trust to his assertion that for a certain number of days he has not been exposed to putrid influences. If it were not possible thus rapidly, and yet thoroughly, to purify oneself it would be necessary to establish special stations and special assistants for all patients whose wounds were not entirely free from any septic character; for every surgeon is liable to be called from a foul wound or a septic inflammation to give immediate attention to some case particularly susceptible to septic influences. At first he felt great anxiety on this point; the bad cases were all isolated, and their dressings were postponed till the last, and after finishing his assistant took a bath and changed his clothes. Now the only cases isolated are erysipelas, diphtheria, and the like. Where he has a long series of operations he begins with those in which the danger of infection is greatest and ends with those already suffering from septic disease. First he opens a peritonæum, then removes a loose body from the knee, then exorcises diseased joints, and finally comes to the acute progressive inflammation."

Under the influence of perfect cleanliness and free drainage the range of successful operations has been greatly widened—the abdomen may now be explored with comparative impunity; all the organs which formerly were considered beyond surgical interference may now nearly all be reached by the surgeon's hand and knife, with the result that many lives are saved that but a few years ago would have been sacrificed.

Electricity has been drawn upon by the profession, and by its aid the desire so long entertained to see within the body for the purposes of diagnosis has been gratified. In 1867 Milliot invented an instrument for lighting up the abdominal cavity so that its contents could be seen through the abdominal wall, but only used it on animals and dead bodies. His experiments led Lazarewitch to apply the same thing to gynæcology, but failed to get light without at the same time getting an amount of heat which rendered the instrument dangerous and useless. Dr. Nietze of Vienna originated the idea of illuminating the interior of the bladder by passing into it a white-hot platinum wire, and the idea was practically carried out by Leitner, the surgical instrument-maker of Vienna. The invention is called the Nietze-Leitner endoscope, and consists of a platinum wire heated by electricity and surrounded by a current of water to keep it from burning the tissues. Sir Henry Thompson spoke cautiously in regard to this invention, but, according to the writer of the article on Surgery in "The Annual Cyclopædia," said there were some conditions the existence of which we sometimes suspect, but cannot positively affirm to exist, whose presence may now be ascertained by this instrument. He referred to the identification of sacculated stone as the cause of existing and unrelieved symptoms; to the detection of growths removable by operation, and to the investigation of the nature of foreign bodies other than calculi which have become lodged there. Sir Henry Thompson added that he had recently seen a fatal case of vesical growth which might have been easily removed by operation; and in such a case the new endoscope might possibly render essential service. In singular contrast with this statement is the fact that in "The International Encyclopædia of Surgery," the sixth and concluding volume of which appeared in 1886, the Nietze-Leitner endoscope has no place, unless it is the vague reference to the "electric lamp" in the extract we quote. Writing on Lithotrity, Dr. W. H. Kingston depreciates Cruisis' endoscope, the use of which he has discontinued, as he "can conceive of no case in which more reliable information cannot be obtained with other means of diagnosis," and, he continues, "as much and as little may be said of the electric lamp, which, however, may some day aid materially in throwing light where much is sometimes needed; and the interior of the abdomen being rendered diaphanous, an opaque body, such as a calculus, may yet be found to cast or receive a shadow. This was suggested to my mind at the meeting of the International Medical Congress in Paris, seventeen years ago, but thus far no advantage has resulted as regards the detection of stone."

The further uses of electricity in surgery are thus enumerated by Dr. Butler:—(1) Electricity is used for the sake of its absorbent effects in the treatment of serious effusions, recent effusions of blood or lymph, cystic tumours with watery contents, subacute and chronic glandular enlargements, and in any case in which absorption is interrupted. (2) On account of its ability to coagulate albumen, it is employed in the treatment of aneurism, nævus and varicosis; and in cases of morbid growths when the object in view is to produce "starvation" (as it were) of the tumour by causing small coagula to form at several places within its structure; which coagula act as interrupters to the free circulation of blood through the growth and interfere with its nutrition so far as to render absorption more easy of accomplishment. Any benign solid growth, the removal or total destruction of which is perhaps injudicious, or at least undesirable, may be so treated. (3) With a view to utilizing its escharotic effects, electricity is exhibited in malignant tumours in hard fibrous strictures, and for the removal of electro-chemical decomposition of any morbid growth, whatever be its structure. From this list we should except osteoid or bony formations, as well as morbid growths which have undergone calcerous degeneration. (4) In virtue of the capacity of electricity to cause muscular contractions, it is often called upon to break up adhesions, as in cases of partial anchylosis, &c. (5) For the purpose of stimulating the process of repair, its effects are brought to bear upon indolent ulcers, and flabby granulations of an ulcerated surface.

During what may be called the dark ages of the art of surgery, when the ignorant priests, and the still more ignorant barbers, were its professors, the instruments were equally rude and disgraceful. Knives, hot irons, screws, files and saws, were the implements that were plied with cruel recklessness on the unfortunate patients, and it was not until the educated school of surgeons grew up that a revolution in the mechanical department of the science took place. It would be impossible to describe adequately the variety of a surgeon's "armamentaria"; we must be content with noticing a few of its characteristics, and observing the remarkable care and skill now exercised in the manufacture of the arms of what is irreverently described as the "modern Sawbones." Mr. Liston, who was *facile princeps* among the operators of his day, speaking of instruments and operations, said the apparati should be in good order, and always within easy and convenient reach of the operator, so that he may, in a great measure, be independent of lookers-on. Before he ventures to begin he should ascertain that everything is arranged and in proper order; more particularly that the cutting instruments have good points, that their edges are keen, and that the joints of forceps and scissors move freely and readily. The principle on which the instrument is made to cut should be well considered. Every knife is to be looked upon as a fine saw; the teeth of some are set forwards, and these cut best from point to heel, as does a razor; but the greater number are set in the opposite direction—for example, the common scalpel and bistoury—and act efficiently only in being drawn from heel to point. Every cutting instrument should be well balanced and placed in a steady, smooth handle; the point should either be in a line with the back, which ought then to be perfectly straight, or both edge and back should be so far convex, the point being in the middle of the blade. Naturally, the manufacturers of the instruments have a great responsibility in making them efficient; but there is little room for anxiety on that score, seeing that Sheffield, the principal seat of the cutlery trade of the world, is entrusted with much the largest share of their manufacture. That desirable state of excellence described as "when the form and physical properties of the instrument are exactly to the wish of the operator," is difficult of attainment; but everything that skill and manipulation can do is done in the factories of the cutlery metropolis. The choicest pieces of steel are carefully selected, and the best workmen are delegated to the forging, hardening, tempering, grinding and polishing. Furnishing the edge, technically termed setting, is a work of much delicacy and skill, and the nature of each particular operation is considered in judging the requisite degree of strength or delicacy of edge. The saws used in surgery are of the best spring temper, while to that class of instruments denominated blunt, shear steel is adapted. Some instruments, such as catheters, and other tubes and probes, are necessarily made of gold and silver, and every year adds to the extraordinary variety upon which the manufacturers have to bestow all that artistic efficiency and ingenuity necessary to keep pace with the prolific surgical instrument-inventor.

CHAPTER XXIII.

THE MODERN HOSPITAL SYSTEM.

Hospitals had a rather curious origin, and the progenitors of the huge benevolent institutions of the present day were as much unlike them as it is possible to imagine. We have the word from ancient Rome. The "hospitall" was the name of the guest-chamber in a Roman's house. The stranger introduced to his host by the recommendation of a third person was safe within the gates of his protector, who was not necessarily his entertainer; for after one dinner with the family, the stranger generally dined in the hospitall and paid for his food. The early Greeks kept alive these customs of hospitality; but the nursing of the sick poor formed no part of them with either people.

Antoninus Pius first caused the erection of a hospital for the sick who crowded in the open air round about the temple of Æsculapius at Epidaurus; and the buildings attached to the temple of Æsculapius at Rome, on the island in the Tiber, formed also a receptacle for the sick. Still these foundations bore no more resemblance to our modern hospitals than do the pump-rooms of Harrogate, Leamington, Cheltenham, or Aix-les-Bains to the wards of those institutions.

The Apostles began the new system of hospitality founded upon the teachings of their Lord and Master, to feed the hungry, lodge the homeless, and heal the sick as well as preach the gospel to them. The earliest of the Church's bishops were most zealous to get money for the sick, the poor, the wayfarer, and the orphan. In the year 325 the Council of Nice had, among other business, to define the qualities and duties of hospital-master, and thirty-five years later Gregory of Nazianzen is found urging Julian the Apostate to imitate, "by the building of hospitals and travellers' rests, the Christians whom he ridiculed." About the same time, Basil the Great speaks of the early Christians as having developed the hospital system into completeness, and he himself founded a general hospital called the Basiliait. John Chrysostom, some years later, erected a great general hospital at Constantinople, "spending upon it and the other smaller hospitals a part of his own substance, as well as the superfluous riches of the Church." Lunatic asylums were founded also at this period by monks in the Wilderness of Bithynia. The earliest hospitals were intended principally for poor travellers, although there were several foundations for rich travellers who needed solace on the road. In the eighth century laymen interested themselves in the work, and in Lucca alone the burghers erected three hospitals, while the German residents established a fourth for their own countrymen.

Milan possessed the first foundling hospital, and the great orphan asylum of the Greek Emperor, Alexius Comnenus, was the forerunner of our military hospitals. The monastic system absorbed the hospitals into itself, and those old piles of buildings that remain to us, such as the hospital of St. Bartholomew the Less, Smithfield, are evidences of that age when charity had another and far different meaning than at present. The advent of the Crusaders and leprosy into Europe from the East, originated the building of leper houses, named Lazarettos, from the hospitals of St. Lazarus, in which the outcast lepers, called Lazari, were received and tended by brothers of the Order of St. Lazarus of Jerusalem. There were even other special hospitals in those days, such as lying-in, small-pox, and lunatic hospitals.

The modern growth of the system may be best traced in the history of what were long known as the "Five Royal Hospitals"—St. Bartholomew, St. Thomas's, Bethlehem or Bedlam, Bridewell, and Christ's Hospital. Rahere, a minstrel, founded the Priory of St. Bartholomew in 1102, and the ancient hospital chapel is still the parish church of St. Bartholomew the Less. In 1547 it was handed over to the citizens of London as a hospital. The Great Fire left it unharmed, but it was rebuilt in 1729, and has since developed into the most comprehensive of such institutions. In addition to the out-patients' rooms and wards devoted to the treatment of ordinary medical and surgical diseases and accidents, there are special departments for skin diseases, diseases of the eye, the ear, and the throat—orthopædic, dental, maternity, and infectious disease departments. St. Thomas's Hospital, the imposing block of buildings on the opposite side of the Thames to the Houses of Parliament, has also an ancient lineage. Until 1871 it was located nearer London Bridge than Westminster, having been founded in the twelfth century. In 1207 the original hospital was destroyed by fire, and it was rebuilt, but not on the same ground, in 1228, by Peter, Bishop of Winchester. Within its walls, in 1537, the first English Bible was printed by James Nycolson of St. Thomas's Spy Hall, in Southwark. The Bible bore the inscription, "Imprynted in

Southwark in St. Thomas' Hospital by James Nycolson. Dedicated by M. Coverdale to the King, 1537." In 1676 it narrowly escaped destruction again by fire, as the following inscription on a tablet over the court-room entrance of the old hospital recorded :—" In the midst of judgement God remembered mercy, and by His goodness in considering the poor and distressed put a stop to the fire at their house, after it had been touched several times therewith, by which in all probability all this side of the Borough was preserved." Owing to railway necessities the hospital had to remove again in 1862, and this time it was located in the Surrey Gardens, where it remained until the completion of the present handsome pile of buildings, which were opened by the Queen a little more than a dozen years ago. Bethlehem Hospital was a priory founded by Simon Fitzmary in 1247. Exactly three hundred years later it was handed over by Henry VIII. for the reception of lunatics. It was rebuilt in 1676, and wings were added in 1733. The present building was constructed in 1810. As for the remaining two of the Royal hospitals—Bridewell and Christ's—they early ceased to be receptacles of the sick.

The great movement in hospital building took place in the eighteenth century, and among the chief institutions founded during that period were the Westminster, Guy's, St. George's, the London, and the Middlesex hospitals. The special institutions established during the same period included the British Lying-in, the City of London Lying-in, the Queen Charlotte, the Small-pox, and the Lock. In the provinces, between 1710 and 1797, hospitals were established at York, Salisbury, Cambridge, Bristol, Edinburgh, Windsor, Aberdeen, Northampton, Exeter, Worcester, Newcastle, Manchester, Chester, Leeds, Stafford, Norwich, Oxford, Leicester, Dumfries, Hereford, Birmingham, Montrose, Nottingham, Canterbury, Glasgow, Dundee, Dublin, &c. During the present century the increase has continued until there is now almost a plethora of such establishments and their auxiliaries.

Besides the civil hospitals there are naval and military hospitals for the cure of soldiers and sailors, and formerly Greenwich and Chelsea were the two great English establishments founded as asylums for disabled and superannuated men of both services. The former, however, is now given up for that purpose, although a part is appropriated as a hospital for sick merchant seamen of all nations. The foundation of the Chelsea home for old soldiers is romantically attributed to Nell Gwynn's influence over her royal lover; but as a matter of fact Sir Stephen Fox, the first Paymaster-General of the Forces, conceived in 1681 the idea of the Chelsea Hospital, and induced the King to take steps to accomplish the object. It was hoped that the public would have contributed largely to the scheme, but, in addition to one thousand three hundred pounds from Sir Stephen Fox, and one thousand pounds from Tobias Rustall, a former page of the back stairs, only two thousand three hundred and forty-seven pounds were thus raised. The King added six thousand seven hundred and eighty-seven pounds four shillings and twopence-halfpenny, the unapplied balance of secret service money. The troops themselves were ingeniously put under contribution towards the project, ultimately justifying the observation of one Chaplain-General in his "Traditions of Chelsea College," that "within the walls of Chelsea Hospital the veteran has indeed nothing to complain of; but why? Because the establishment is his own, built by his own or his predecessors' money, supported out of funds which the nation never gave. The in-pensioner, therefore, though he has no complaints to make, owes nothing to the generosity of the House of Commons." Chelsea Hospital was originally called Chelsea College. The lands about Chelsea and Battersea were formerly Church property, belonging to the Abbot of Westminster, but at the Reformation all but a small portion passed into the hands of private owners. On a part of the reserved land, James the First resolved to build a college for the study of polemical divinity. The building was begun but was stopped for want of funds. Under the Commonwealth, the place was used for the confinement of political offenders and prisoners of war, and it was not until 1692 that the building was appropriated to the admission of pensioners. Since then it and its inmates have passed through exciting times. In the chapel and hall are the evidences of these, including the remains of French colours captured in Marlborough's wars. The wards and galleries of the establishment are long, lofty and airy apartments. In the galleries the men take their meals, and the rations from the following description may be described as good, ample and satisfactory. Each man receives daily one pound of bread, one ounce of butter, a quarter of a pint of the best new milk, with three-quarters of an ounce of cocoa, and one ounce of moist sugar for breakfast, and one-sixth of an ounce of tea, and three-quarters of an ounce of moist sugar for tea. For dinners each man has, on Sunday, thirteen ounces of beef, one pound of potatoes and plum-pudding; on Wednesday he gets ten ounces of bacon and one pound of cabbage, or other vegetable; on the other five days he obtains thirteen ounces of mutton, one pound of potatoes, and one-and-a-half ounce of Scotch barley.

A sufficient quantity of herbs, oatmeal, salt, pepper, and mustard is supplied. On Fridays half a pound of cheese is served out; and every day a pint of porter. On Royal birthdays special rations are given. The regulations admitting visitors are very liberal, and how well the inhabitants of the hospital are looked after may be judged by their longevity. By far the greater majority of patients exceed the allotted span of life, and not very many years ago one of the inmates died at the great age of one hundred and eight.

Our other principal military hospitals are the Royal Victoria Hospital at Netley, the Herbert at Woolwich, and the Cambridge at Aldershot. The Naval hospitals are at Haslar, Plymouth and Chatham.

The administration of the civil hospitals is usually carried on by a body of Governors who are either specially appointed or are benefactors of the institution. From them an executive committee is chosen, or the executive power may be vested in a single official—often the Treasurer. In the latter case controversies are not unusual, such as the one which occupied the pages of two of the leading Reviews a few years ago anent the nursing system adopted at Guy's. With the financial and general management of affairs the secretary or superintendent has to do, while an apothecary superintends the pharmaceutical department. The treatment of the sick is, of course, entirely in the hands of the physicians and surgeons, whose appointments are for the most part honorary, in the sense of being unpaid, and under whom resident medical officers act.

One of the most serious difficulties with which hospital authorities have had to deal is the out-patients' department. Such a department was unknown in the original design of a hospital, although there can be little doubt that it was the existence of it which led Macaulay to write in his History that "every bricklayer who falls through a scaffold, every sweeper of a crossing who is run over by a carriage, may now have his wounds dressed and his limbs set with a skill such as 160 years ago all the wealth of a great lord like Osmond, or of a merchant prince like Clayton, could not have purchased." The latest figures compiled in this connection show that in London alone one million one hundred and sixty-eight thousand persons are on an average relieved in one year; or, to put it more significantly, out of a population of over five millions one-fourth receive actual benefits from the hospitals. In 1871 a committee of doctors, appointed at one of the largest meetings of their profession ever held in London, reported that the out-patient system was one of the most mischievous examples of indiscriminate charity; that the practice of giving medicine freely and gratuitously at hospitals formed one of the most fruitful sources of demoralization and abuse; that hundreds, if not thousands, of the out-patients who suffered from debility, arising from the insanitary condition of their homes, want of wholesome and sufficient food, and other causes tending to depress the vital powers, were tempted to go to hospitals by the relief which tonic medicine was often found to give them, but that this empirical mode of treatment was very unsatisfactory, and was attended by great and unnecessary expense—that at least one-half of the patients relieved at hospitals could not, from their comfortable social position, be considered proper objects of charity; that the excessive numbers of those who were seen, three-fifths to nine-tenths of whom were considered by the Committee to be suffering from trivial ailments not requiring hospital treatment, prevented proper attention being paid to each individual case, and fostered a habit of hasty diagnosis and careless observation on the part of the medical staff, which tended to erroneous and ineffective treatment, and that in fact much work done in the out-patient department of hospitals neither conduced to the sound advancement of professional knowledge nor to the advantage of the public. This view was followed up by Sir Charles Trevelyan, who wrote numerous letters to the *Times* in 1873, pointing out that medical treatment was provided in London for the entire working class on a purely gratuitous eleemosynary footing through the out-patient department of hospitals and the free dispensaries; that the great bulk of the people were thus being educated to dependent mendicant habits, and that instances frequently occurred of the corruption extending to the middle classes; that the out-patients' departments were so crowded that it was impossible to give to serious cases the attention they required, and that those for whom the charity was really intended wasted their strength in unavailing attendance; and, finally, that the burden of providing gratuitous medical relief for the bulk of the metropolitan population, being beyond the power even of London charity, the public ear was constantly harassed with lamentable appeals of empty beds and bankrupt exchequers.

The most remarkable statement, however, of the abuses connected with the out-patient system was given by a writer in *Fraser's Magazine* in August 1874. It was contained in a memorial presented to the Weekly Board of St. George's Hospital in March of that year. The signatories included the Duke of Westminster, the Earl of Shaftesbury, Lord Eversley, Mr. Gathorne Hardy, Sir James Paget, Sir William Fergusson, Sir William Gull, the Rev. Mr. Liddell, and Mr. Thomas Hughes, who set forth that the out-patient department of St. George's, and the neighbouring free dispensaries, by their gratuitous provision for even the most ordinary medical treatment of the working classes, had, however unintentionally, largely contributed to encourage them in improvident and mendicant habits; that owing to the numbers flocking to receive gratuitous medical relief, and to the limited time at the disposal of the medical officers, it had been found impossible that each case should receive proper examination and treatment; that something had been lately done towards remedying this by limiting the numbers of new cases seen every morning by each medical officer, but that this did not touch the root of the evil, while it superadded some new inconveniences.

Under such circumstances it was not surprising that a few of the hospitals failed to some extent in affording that relief to out-patients which had been added to the original design. One of the leading medical journals thus described the method of "getting through the patients" a few years ago. The out-patients are divided into two categories, which, however, are neither very well defined nor very well observed. These are the "casualty," which comprises those who are supposed to require temporary treatment for diseases or injuries of a trifling character, and the out-patients properly so called, who, after receiving a regular letter of admission, are entitled to the advice of the assistant physicians and surgeons for a period of two months. The casualty patients are attended to in a new building situated at Smithfield, at the north-east corner of the hospital property. It consists of a large, well-ventilated room, capable of seating about 600 persons. The males sit at one end and the females at the other. On the north side are two small consulting rooms for medical cases, and on the south side are four others in which the patients are examined and their wounds dressed. In the centre there is a rough dispensary, in which six different mixtures are kept in large brown jugs; there are also some gargles, lotions, and pills of a simple character. The medicine in the jugs is dispensed by two female nurses, and the dose is often ordered to be taken on the spot. The following is a sample of the amount of work done in one day, and the way it is done:—One physician was required to see and prescribe for one hundred and twenty-five men, and another physician for one hundred and sixty-five women and sixty-two children. These were all new cases whose symptoms ought to be inquired into, their diseases ascertained, and remedies prescribed for them, and in addition to these a considerable number of old cases had to be seen. After some hours of steady work it was found necessary to hurry over the remainder, and one hundred and twenty patients were seen and dismissed in an hour and ten minutes, or at the rate of thirty-five seconds each. Who shall say what mistakes were made by the doubtful doses of physic ordered at random and poured out of a huge brown jug, as if the object were to get rid of troublesome customers rather than cure their complaints?

It is a gratifying fact that no such serious allegation can be made against the in-administration of our hospitals. The patient has a bed assigned to him, where the cubic space is carefully proportioned to the number of inmates. He has provided for him the particular diet which suits his complaint; he is attended by trained nurses; the symptoms of his illness are systematically noted, and any change from day to day is duly recorded. He is visited once or twice daily by the house physician, or house surgeon, neither of whom, however, undertake the treatment of his case, that being entirely reserved for the visiting physicians and surgeons, who are in most cases men of the highest standing in their profession. They are men, moreover, who above all the other professions put together give more gratuitous service to mankind. Their skill, time and talents they devote almost entirely to hospital labour, and they are seconded by those indefatigable women workers — the nurses — of whom Florence Nightingale was an early pioneer. The extent of their labours may be gathered from a few current statistics. The largest general hospital is the London, in Whitechapel Road, in the East-end of the Metropolis. At its foundation, in 1740, it was situate in the midst of green fields and charming pastures; now it is in the centre of a vast population of working people, many of whom have recourse to its "hospitality" during the year. It contains 790 beds, and night and day surgeons and doctors are kept on duty to receive the injured or sick who may be brought to its portals. The patients are kept until cured without any charge, and in 1885 it accommodated 8,106 in-patients, in addition to treating 67,942 out-patients. In this institution the bread in a twelvemonth costs over £1,000, the meat over £6,000, milk more than £2,000, and eggs nearly £1,000. Fish absorbs £600 of the income of the London Hospital; firing £1,700, lighting £1,200, drugs £3,300, and plasters nearly £400. At Guy's Hospital there is a strong permanent medical staff, who have to treat on the average about 5,000 in-patients a year, and 85,000 out-patients; the ten or a dozen medical men at St. Bartholomew's treat 6,000 in-patients, while thirteen have the nominal care of one hundred thousand out-patients; and at St. Thomas's, with a similar staff to Guy's, the in-patients number about 6,000, and the out-patients 66,000.

Of the special hospitals devoted to the treatment of individual diseases, the Cancer Hospital, the Consumption Hospital at Brompton, and the Great Ormond Street Hospital for sick children, are the principal, although they are by no means the only institutions of their class. In all there are more than one hundred hospitals in London, and although the cost of in- and out-patients per head varies considerably at each of them, yet the average shows that each bed costs £1 14s. 4d. per week, or a total for the year of £535,600, while the out-patients cost an aggregate of £137,550. This makes the total of hospital expenditure in one year £673,150, and upon the most recent returns available we find that the income of hospitals and dispensaries reaches but £675,000. The contributions towards the maintenance of the institutions have been largely augmented in recent years by the adoption of the Continental practice of a special collection on one Sunday in the year. Dr. James Wakley, the editor of the *Lancet*, started the Metropolitan Hospital Home Fund in 1873, and a table showing the amount of the collections and the number of the congregations contributing displays a gratifying development of the scheme. For instance, in 1873, one thousand and twenty-two congregations contributed £27,700 8s. 1d., while in 1886 fifteen hundred and ninety-five congregations made up a total contribution of £40,399 7s. 7d.

Cottage hospitals, convalescent homes, and provident dispensaries are among the many offshoots of the larger system, and especially has the number of dispensaries grown within the last few years. That at West Ham takes the credit for having treated the largest number of patients in one year, viz., 17,829, in 1885. The Western General Dispensary came next, with a total of 16,716 patients. Of course, it is needless to say that the public dispensaries to which we now allude are not to be confounded with the private dispensaries set up by medical men quite legitimately for their own benefit, but which are not unfrequently conducted on the lowest of commercial principles. The public dispensaries of London, with their committees of management and staffs of physicians and surgeons—who in the case of the free dispensaries are almost invariably honorary—do excellent work, and are worthy of more than all the support they obtain. They undertake the treatment of diseases at the patients' own houses, and by calling in the aid of the nursing institutions they are not only able to supply medical attendance and medicine, but also trained nurses.

All such institutions, therefore, must be considered to be foremost among the monuments of benevolence and piety, for to the philanthropist, the remembrance of how many hundreds of his fellow-men are annually relieved or cured of some form of sickness or suffering in them; to the medical man, who knows how much his art is indebted to the experience gained within their walls; and to the general public, who receive both directly and indirectly the advantages which they bestow, the great hospitals of the present day retain something of the sacredness that once invested the monasteries which preceded them.

CHAPTER XXIV.

THE ROYAL HUMANE SOCIETY.

"PERADVENTURE a little spark may yet lie hid." How many sparks of expiring nature, we wonder, has the Royal Humane Society been instrumental in fanning into the flame of renewed life, health and vigour, during its history of more than one hundred years? Within the last fifty years about twelve thousand persons have been rewarded by the Society for saving life from drowning alone, and most of those will be familiar with the appropriate motto which we have quoted. It encircles in Latin upon the front of the Society's medal the figure of a boy blowing an extinguished torch in the hope, *Lateat scintillus forsan.* Under the device, also in Latin, is the record that the Royal Humane Society was established in London in 1774, "for the recovery of persons in a state of suspended animation." There is not a benevolent society in existence worthy a higher place on the scroll of fame than the noble organization initiated by Doctors Hawes and Cogan more than a century ago, and continued in uninterrupted usefulness to the present time, and we doubt whether, among all the claims upon the generosity of Englishmen to-day, there is an institution more worthy of support than that which has its head offices at 4, Trafalgar Square, London, and whose affairs are administered with such conspicuous discrimination and ability by Captain I. W. Home.

The art of resuscitating the apparently dead would appear to have been unknown in ancient times. About the middle of the last century the penetrating genius of an Englishman, Dr. John Fothergill, saw the "dubiousness and fallacy of the received criteria of dissolution." In a paper addressed to the Royal Society, and recorded in their Transactions, he maintained "the possibility of saving many lives without risking anything"; but, strange as it may appear to-day, the subject aroused little or no attention in the learned and philosophical world. The idea still prevailed that death ensued the moment respiration ceased. "Temerity and ignorance," wrote Dr. Hawes, "guided by prejudice, still continued to ravage the human species—man still persevered in being the executioner of innocent man, and numbers were still consigned to that most horrid of deaths, a subterraneous one." Though the suggestion was an Englishman's, yet the glory there was in making the first experiments as to the theory was snatched from us by foreigners; it was in Switzerland, in 1767, that the first instances of resuscitation occurred. M. Reaumur, well known by his theory of animal instinct, was the practitioner who made the reports of these cases to the French Academy of Sciences. Shortly afterwards, a "Society for the Recovery of the Drowned" was instituted at Amsterdam, and it was the Transactions of this Society that Dr. Cogan, a learned and judicious physician, translated in 1773, and which enlisted the sympathy of Dr. Hawes. The translation was made by Dr. Cogan with the object of convincing the people of this country of the practicability of resuscitating the apparently drowned. To the ardent and indefatigable mind of Dr. Hawes a career of public usefulness was thus opened up, which he pursued till his death. Finding that a strong and general prejudice existed against the theory of resuscitation, and that the idea was even ridiculed as hopeless and chimerical, he determined to demonstrate it. With this view he publicly offered rewards to persons, who between London and Westminster Bridges, should, within a certain period of the occurrence of an accident, rescue the bodies of drowned persons and bring them to places appointed on shore for their reception, in order that the means of resuscitation might be tried. At these places he and his friends restored several lives. During one whole year Dr. Hawes continued to pay these rewards himself; but at the end of this period Dr. Cogan represented to him the injury his private fortune must sustain by such continued expenses, and kindly offered to unite with him for the formation of a Humane Society. By dint of much personal effort and influence the two doctors obtained the support of the following thirty-two gentlemen, who were first members, and therefore the founders, of the present noble organization :—Doctors William Cooper, Oliver Goldsmith, Heberden, Kooystra, Lettsom, and Watkinson; the Revs. — Bouillier, Richard Harrison, Dr. Jeffries, M. Snowden, Dr. Towers, and van Essen; also Messrs. Armiger, Fred Bull, Delver, Denham, William Fox, Benjamin Hawes, James Horsfall, F.R.S., John Jacob, Joseph Jacob, Robert Palmer, Patten, Michael Pearson, Phipps, Samuel Prime, John Bewlay Rich, Thomas Tower, W. Towgood, William Townsend, Warrand, and Wright.

At first the efforts of the Society were confined to the recovery of the apparently drowned, as was the case with similar societies on the continent, which seem to have sprung up almost simultaneously with the Amsterdam organization; but in a very short time the English Society had extended its sphere of usefulness. Its timely succour roused the lethargy produced by opium taken in immoderate and repeated doses, rescued the wretched victims of intoxication, rekindled the life extinguished by the sudden stroke of lightning, recovered the apoplectic, restored life to the infant that had lost it in the birth, provided efficacious remedies in cases of accidental smothering, and of suffocation by noxious damps—in fact, in time no species of death seemed to be placed beyond the reach of the Society's assistance, where the mischief had gone no farther than an obstruction of the movements of the animal machine without any damage of the organs. The resuscitative process also began to be applied, through the instrumentality of the Society, and with "happy success, to counteract the fatal effects of a most heinous crime, said by foreigners to be almost peculiar to this country —suicide." The very idea of the possibility of being restored, or brought back to life, it was thought in those days, "must operate to repress the audacious and impious hand of him who is eager to hurry out of existence." Mr. John Milward, a gentleman distinguished by his benevolent and professional knowledge, was the first medical assistant of the Society who furnished examples of the "practicability of restoring persons stricken apparently dead by lightning." Dr. Fothergill enjoyed the pleasure of living to see the rules adopted which he had recommended thirty years before.

Dr. Hawes continued the moving spirit of the Society. He managed its affairs, promoted its efficiency, edited its Transactions, and compiled the annual reports. The first volume was dedicated to King George III., who manifested a deep interest in the organization, and in an Introduction Dr. Hawes indulges in observations connected with the subject with a view of engaging the "regard and attention of the philanthropist, or scientific inquirer." In conclusion, the Doctor says that his "great object has been to allure the advocates of humanity and science to the discussion and investigation of an important cause which has been ever dear to him. He trusts he is neither rash nor presumptuous in cherishing the pleasing hope that there is no person whose breast is alive to the feelings of social nature that can read the following pages without feeling himself elevated above the common level of humanity—that there is no inquirer into the doctrine exemplified in the following Transactions, who will not find some hints capable of leading the sagacious mind to the discovery of consequences valuable to science and useful to mankind. But, whatever may be the judgment of the candid and impartial concerning his labours in recording the Transactions of the Society, he cannot repress the sensations of almost parental pleasure which he feels in the survey that this work has occasioned him to take of the rising state and rapidly increasing importance of an institution, the establishment and promotion whereof have employed the best part of his rational life. He cannot but declare that he feels all his labours amply rewarded in beholding this institution arrived at a maturity which promises to resist the fate of the varying fashions that rise and sink in the stream of life. The Editor feels himself abundantly consoled, and even remunerated, for all his cares, all his anxieties, and all his solicitudes, when he considers and reflects on the stability the Humane Society has acquired in the conviction of the public mind, and, above all, in obtaining the patronage of a

Sovereign whose virtues, as they constitute the happiness of the present age, will afford the richest theme of praise to the admiration of posterity. Such acquisitions will enable the institution to diffuse its blessings to the human race when Providence shall permit him no longer to be an agent in administering these blessings to his fellow-creatures, or the feeble organ of recording these noblest offices of humanity for the instruction and information of unborn ages." Not many years afterwards, and at the ripe age of 72, the good doctor passed away at his house at Islington, leaving a great gap to be filled in the administration of a Society which had been almost his idol for a period of thirty years.

When the Society had been established a twelvemonth upwards of twenty objects, in most of whom the vital powers seemed to have been totally suspended, had been brought back to life, and on the first anniversary there were presented to the public view ten persons who had been brought from the "confines of the region of death." The youngest of the ten had been under water a quarter of an hour, and upwards of forty minutes had elapsed before any proper assistance could be procured. And yet after attentive perseverance of four hours he was restored to life. Such instances as these sufficed to establish the Institution in public favour, in which it has continued to grow through an unexampled career of usefulness. The plan of the Society was rapidly adopted in provincial towns. In 1776 Liverpool established an auxiliary, and Norwich, Hull, Worcester, Chester, Kidderminster, and Dublin also adopted the plan; in 1777 Colchester and other places followed suit, so that in a very short time the humanizing influence inaugurated by Dr. Hawes spread like a network over the land.

One of the earliest peculiarities of the means adopted to enhance the popularity of the institution was the annual sermon. The first was preached by the Rev. Mr. Harrison from the text, "As we have therefore opportunity let us do good unto all men," and upon each succeeding anniversary of the foundation of the Society, some divine of more or less prestige advocated the claims of the humane institution to the general public. Among others Dr. Samuel Glasse, one of His Majesty's Chaplains, preached for the Society, and one of his sermons, delivered in the parish church of St. Botolph, Aldersgate, London, on the 27th of March, 1793, was remarkable for the following address to the King, which preceded the discourse:—"Your Majesty's gracious patronage of a Society which has for its object the preservation of the lives of your subjects, and whose efforts have been blest with such eminent success, entitles your Majesty to the most grateful acknowledgments from every friend to its prosperity. Your Majesty in the following pages will have the satisfaction of seeing this Humane Institution happily advancing under your Royal auspices and under the favour of many great and good persons among your subjects. Its reputation and its benefits are not limited to Great Britain, or even to Europe; they are extended to America and to the West Indies. Many countries have been supplied with the apparatus necessary to restore suspended animation; by which very considerable expense has been cheerfully incurred by the Society. Liberally supported, as it has hitherto been, this establishment will be found to rise yet higher in the public esteem, in proportion as its benefits are felt and known. And in proportion to the service which it is doing to mankind will be our hopes of securing the continuance of your Majesty's protection, the encouragement of a generous nation, and, above all, the favour and the blessing of Him in whose hands are the issues of life and death, without whose aid the wisdom of the wise will be frustrated and the best exertions of human industry will fail of their desired effect."

But of all the discourses which have been enlisted in the services of the Society that of Mr. Rowland Hill was the most extraordinary, though characteristic. Mr. J. T. Smith, in his "Book for a Rainy Day," relates how that one Sunday morning, in his younger days, he was passing Surrey Chapel on his way to Camberwell, when the "swelling pipes" of the organ had such an attraction that he was induced to go inside. "No sooner was the sermon over, and the blessing bestowed, than Rowland electrified his hearers by vociferating, 'Doorkeepers, shut the doors!' Slam went one door; bounce went another; bang went a third; at last, all being anxiously silent as the most importantly unexpected scenes of Sir Walter Scott could make them, the pastor, with a slow and dulcet emphasis, thus addressed his congregation:—'My dearly beloved, I speak it to my shame, that this sermon was to have been a charity sermon, and if you will only look down into the green pew at those—let me see—three and three are six, and one makes seven, young men with red morocco prayerbooks in their hands,—poor souls! they were backsliders, for they went on the Serpentine river and other distant waters on a Sabbath; they were, however, as you see, all saved from a watery grave. I need not tell ye that my exertions were to have been for the benefit of that benevolent institution, the Humane Society. What! I see some of ye already up to be gone; fie! fie! fie! never heed your dinners;

don't be Calibans, nor mind your pockets. I know that some of ye are now attending to the devil's whispers. I say, listen to me! take my advice, give shillings instead of sixpences; and those who intended to give shillings display half-crowns, in order not only to thwart the foul fiend's mischievousness, but to get your pastor out of this scrape; and if you do I trust Satan will never put his foot in this circle again. Hark ye! I have hit upon it, ye shall leave us directly. The Bank Directors, you must know, have called in the dollars; now if any of you happen to be encumbered with a stale dollar or two, jingle the Spanish in our dishes; we'll take them, they'll pass current here. Stay, my friends, a moment more. I am to dine with the Humane Society on Tuesday next, and it would shock me beyond expression to see the strings of the Surrey Chapel bag dangle down its sides like the tags upon Lady Huntingdon's servants' shoulders. Now, mind what I say on this occasion, I wish for a bumper as strenuously as Master Hugh Peters did when he recommended his congregation in Broadway Chapel to take a second glass.'"

The King evinced a much more practical interest in the Society than merely becoming its patron, as the present receiving house in Hyde Park is a present-day testimony. Early in its career the Society made a celebrated hostel in the vicinity of what is now Albert Gate, its receiving house for patients from the Serpentine. "The Fox and Bull" was the name of the inn, said to have been founded in the reign of Elizabeth. Here for a long time "was maintained that Queen Anne style of society, where persons of 'parts' and reputation were to be met with in rooms open to all. A Captain Corbet was for a long time at its head; a Mr. Shaw, of the War Office, supplied the *London Gazette*, and

W. Harris, of Covent Garden Theatre, his playbills." Among its visitors were George Morland, and his patron, Sir W. W. Wynn, and occasionally Sir Joshua Reynolds, who painted its sign, which was blown down in a storm in 1807. While the house served as the Humane Society's receiving house, there was brought to it the body of the first wife of the poet Shelley, after she had drowned herself in the Serpentine. George III. granted a plot of ground contiguous to the Serpentine, on the north side, for the erection of a receiving house, in order that immediate and judicious medical aid might be afforded to the accidentally drowned, and those who in a state of despondency had adopted the dreadful resolution of terminating their existence therein. A Committee, consisting of the Rev. Mr. Harrison, Dr. Hawes, Mr. Cranage, and Mr. Jackson, was appointed by the Court of Directors to superintend the building, &c., which, when finished, was furnished with the most approved appliances in the shape of electrical machine, couchette, warm bath, &c. The present building, however, supplanted the old one, of which it is an extension, through the generosity of William IV., in 1834, and is from the design of Mr. J. Bunning. The first stone was laid by the Duke of Wellington. Over the Ionic entrance is sculptured the face of the Society's medal—the boy, the torch, and the appropriate motto. The house contains, beside, accommodation for the resident superintendent and boatmen of the Society, two wards, a surgery, and committee room. The wards are furnished with two baths and six beds, and, when filled with hot water, the bedding becomes heated; the object of which is to keep up the temperature of the body after the patient is moved from the warm bath to the bed. There are likewise two hollow iron tables with pipes leading to a boiler, through which the hot water circulates, keeping the hot water bottles, &c., warm, and the rooms at a high rate of temperature. About two tons of water are thus constantly kept hot throughout the year, and by these arrangements a warm bath can be obtained night or day, immediately. A stretcher is kept at the receiving house ready for carrying persons in cases of accidents by equestrians, &c. When an accident occurs, and while the boatmen are engaged in recovering the body from the water, a messenger is dispatched for the medical attendant outside the park; thus no loss of time occurs, which is so essential in cases of suspended animation.

Receiving houses were provided in numerous other places, such as along the course of the Thames, as well as on the banks of the river Lea, and other rivers and canals. Medical assistants were nominated in every town and village, where their services were likely to be called into action. Honorary medallion awards were instituted to humane, skilful and successful exertions of individuals, and pecuniary rewards commenced to those by whose skill or humanity a human life was saved—in short, the attention of the Committee was given to every possible means by which the objects of the Society might be promoted, and sudden and accidental death prevented.

When the Society had been established fifty years it was enabled to report that Great Britain and Ireland boasted forty-eight societies in their principal towns and ports, together with four in the British colonies. Russia, Prussia, Denmark, America, Bohemia, and the Duchy of Nassau had formed similar associations in their various dominions. The Emperor of Russia had taken peculiar interest in the subject, and once had himself the supreme happiness of causing the restoration of one of his subjects. On a progress through Poland, his Imperial Majesty was, by chance, separated from his attendants, and seeing some persons busied on the bank of the river Wilna, curiosity prompted him to alight from his horse and approach them, when he found they had just taken from the water the body of a man to all appearance drowned. The Emperor assisted to undress the body and revive it, and while thus employed his suite, among whom was an English surgeon, joined him. The attempt to restore animation was at length given over, three hours having been employed in apparently useless endeavour. At the instance of the Emperor, however, the attempt was renewed and was successful. On the return of life to the object of his humanity the Emperor exclaimed, "Good God! this is the happiest moment of my life." The gold medallion of the Royal Humane Society was voted to his Majesty and graciously accepted.

Within the half century the Society had paid rewards to nearly twenty-one thousand claimants for having rescued persons from drowning. Heroic and affecting instances were among them, in which individuals, from a spirit of humanity, had exposed their own persons to the most imminent hazard in order to save a fellow-creature; while, stimulated by the rewards offered by the Society, men had fearlessly plunged into the water and trusted to their strength and dexterity for success in bringing persons who were sinking to shore; or a rope had been carried round the body of a bold swimmer, frequently through the midst of a raging surge, and the deliverer and the delivered had returned together in triumph from the frightful waters. Under the second head of the Society's operations, viz., the restoration of individuals who, from whatever cause, were in a state of suspended animation, more than 5,000 persons had